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A SMALL PORTABLE FORGE FOR AMATEURS' WORKSHOPS.

BY "CYCLOPS."

THERE are many operations required to be performed in an amateur's workshop which necessitate the use of a smith's hearth, and where this useful appliance is not possessed by the workman it becomes necessary to put work out, entailing loss of both time and money.

It is my purpose in this article to describe a simple smith's hearth or forge, which has two distinct advantages. First, of being easily made by the average amateur iron-worker; and, secondly, of great portability. The latter is of considerable moment in the amateur's workshop, which is generally rather cramped. The appliance consists of a wrought-iron frame, on the top of which is the tray, or hearth proper; and underneath the hearth, the bellows and blowing arrangement for the draught. A general idea of this may be gained from a glance at Fig. 1.

Framework, etc.—The framework consists of four legs, A, A, A, A (Fig. 1), braced to-

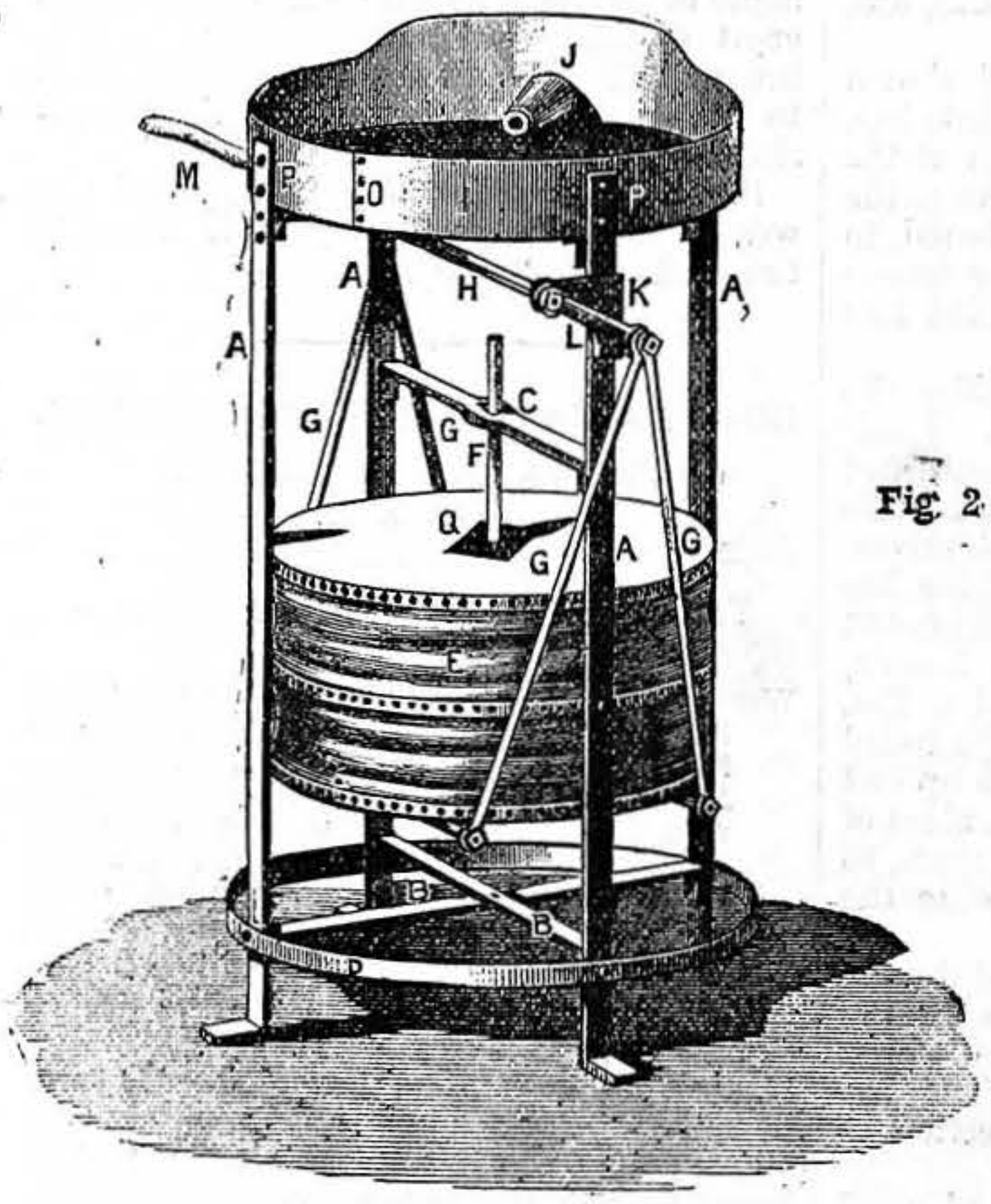


Fig. 1.

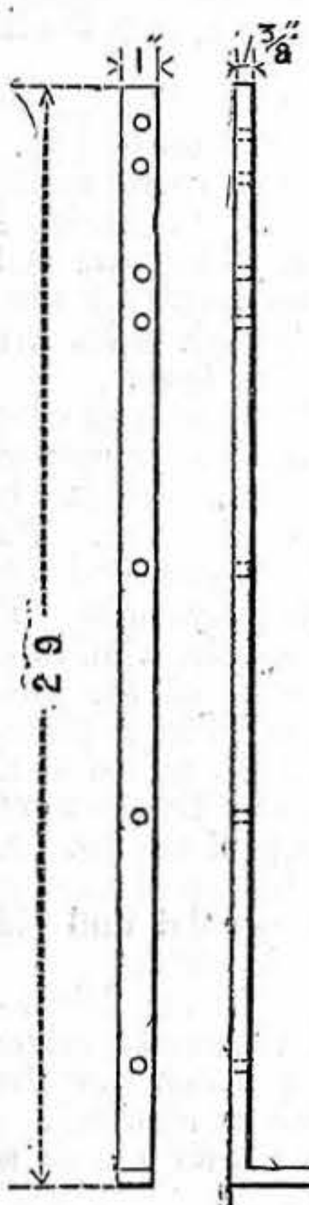


Fig. 2.

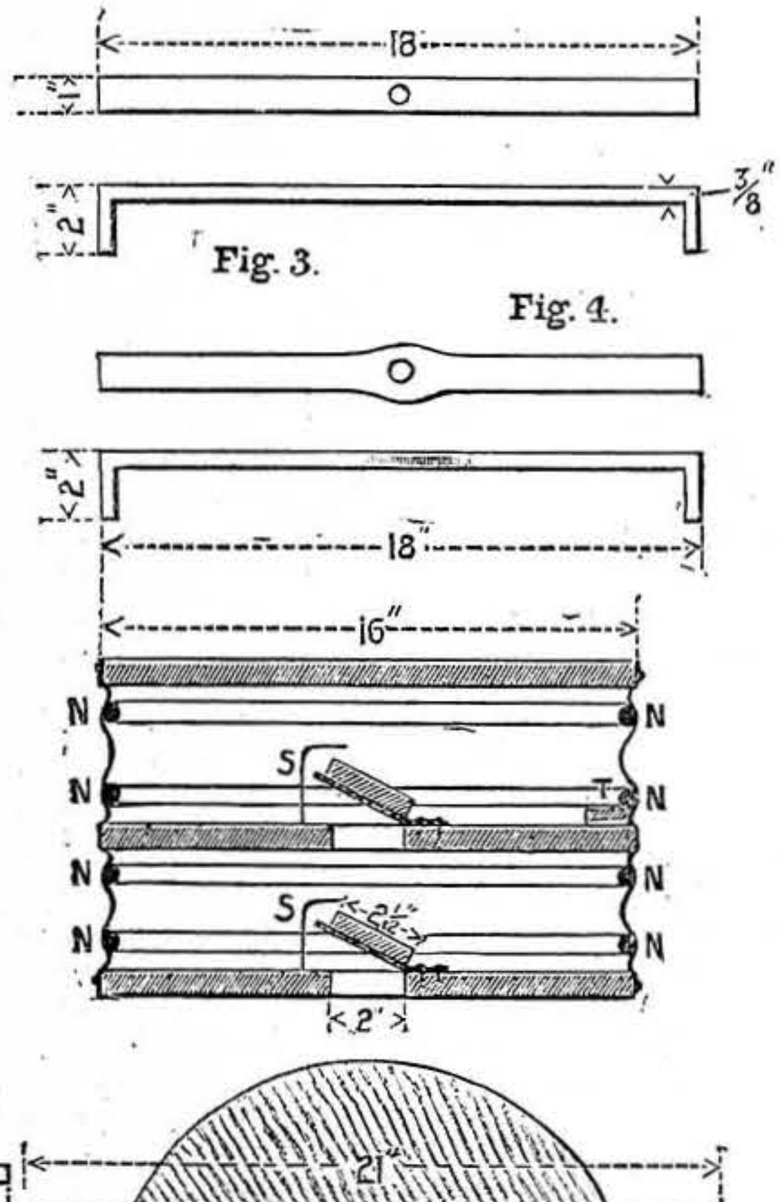


Fig. 3.

Fig. 4.

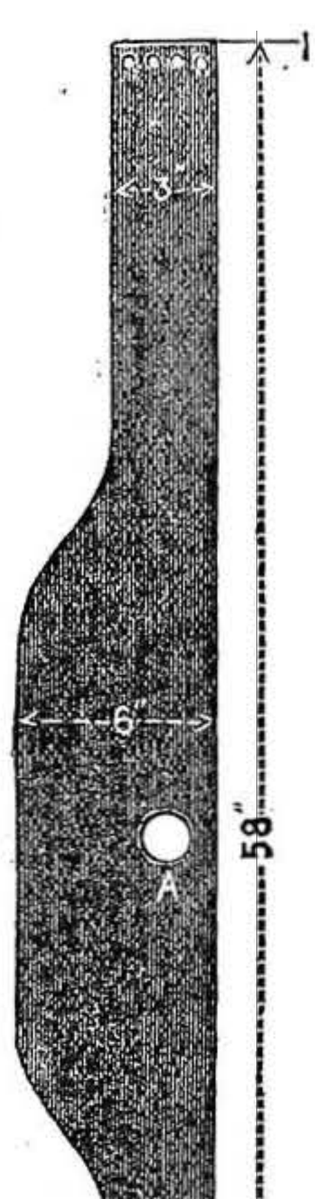


Fig. 5

Fig. 6.

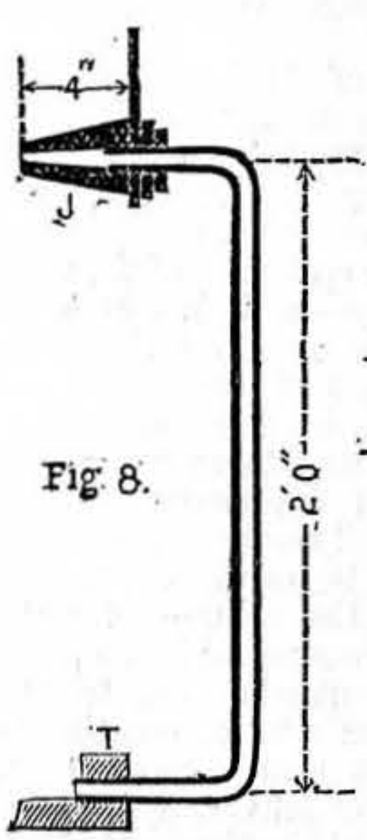


Fig. 8.

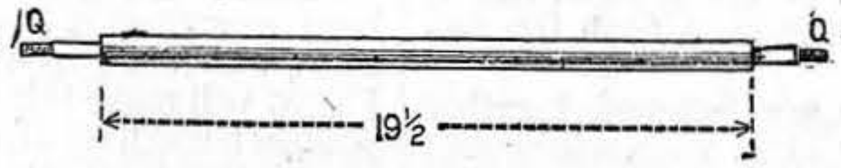


Fig. 9.

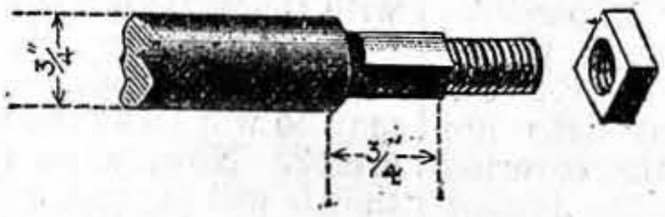


Fig. 10.

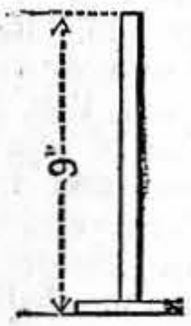
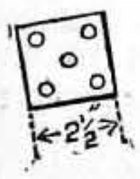


Fig. 7.



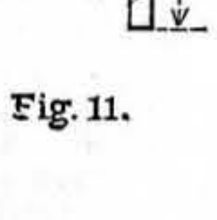


Fig. 11.

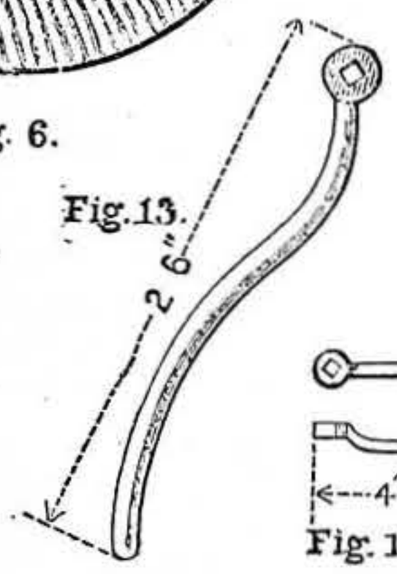


Fig. 13.

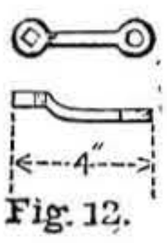


Fig. 12.

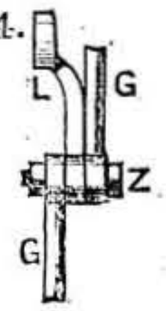


Fig. 14.

Fig. 1.—Hearth complete. Fig. 2.—Front and Side Elevation of Legs. Fig. 3.—Plan and Side View of Bottom Stays. Fig. 4.—Plan and Side View of Guide-Stay for Bellows. Fig. 5.—Sheet Iron cut to form Side of Tray. Fig. 6.—Section and Under View of Bellows. Fig. 7.—Guide-Pin for Bellows. Fig. 8.—Nozzle and Bellows Connection. Fig. 9.—Spindle. Fig. 10.—Bellows Links. Fig. 11.—Bracket. Fig. 12.—Crank on end of Spindle. Fig. 13.—Lever on end of Spindle. Fig. 14.—Links and Crank Connection.

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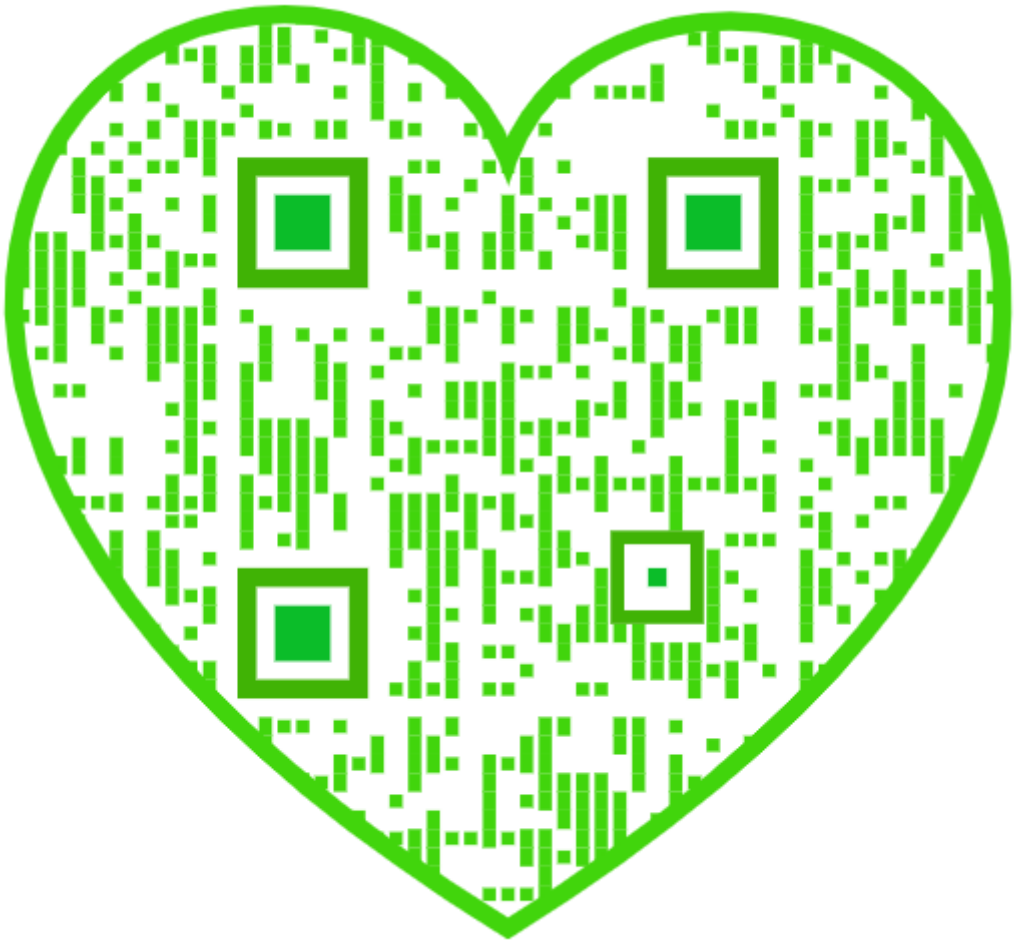

gether by the cross-stays, B, B, two above and two below the bellows. The two stays above the bellows are not shown in the drawing, being hidden by the tray, etc. They are of the same form and dimensions as the bottom pair, except at the centre, where they cross each other, one of them being cranked down to allow the other to cross it at its own level, and thus make a level bed for the hearth-tray to rest on. One of the legs A, A, A, A, is shown separately in front and side elevation in Fig. 2.

The whole of the framework is made of 1 in. by $\frac{3}{8}$ in. square iron bar, and is riveted together by $\frac{3}{8}$ in. by $\frac{7}{8}$ in., and $\frac{3}{8}$ in. by $1\frac{1}{4}$ in. iron rivets, the holes being bored to allow the rivets to fit in rather tight. The dimensions of the various members of the framework being all marked in the drawings, it will not be necessary to mention them here.

The various parts of the framework should first be forged and cut to dimensions given in drawings, and fitted against one another to make sure that they are all exact before marking out for drilling. The two cross-stays, B, B (Fig. 1), are riveted together where they cross in the centre of the frame as shown. The ring, D (Fig. 1), is placed round the outside of frame at the points where the cross-stays are riveted to the legs, and the rivets pass through the ring, D, legs, A, A, A, A, and cross-stays, B, B, binding them all securely together.

The Hearth.—The hearth consists of a flat, round plate of iron, which should be a good thickness to withstand the heat; or, if a little extra expense is not objected to, it might be made of thinner material and a circular fireclay brick bottom placed on it. This would make a much more serviceable job.

The hearth-plate rests on the top pair of cross-stays, and is riveted to them by four rivets, two in each stay. The circular band, I, surrounding the hearth is cut out of $\frac{3}{16}$ in. sheet iron to the plan shown at Fig. 5; the hole A is for the introduction of the air-nozzle, J, from the bellows. The band is riveted to the top of each leg by two rivets, as shown at P, P (Fig. 1), and is also riveted together at its two ends, as shown at o (Fig. 1), by four rivets. The hearth-plate before-mentioned is cut to exactly fit inside the band, I, and to rest on the top pair of cross-stays.

Bellows Fittings.—The bellows work next occupies our attention. It consists of a spindle of $\frac{3}{4}$ in. round iron, working in two brackets, shown at K (Fig. 1), the form of which is better shown in Fig. 11, the dimensions being marked to it. These brackets are riveted, one to each of two opposite legs, by two rivets in each as shown in Fig. 1. The spindle is shown at H (Fig. 1), and also in Fig. 9, the ends, Q, being squared to fit the small cranks, L (Fig. 1), and the long lever, M (Fig. 1). These cranks are shown in plan and elevation in Fig. 12, and the long lever in Fig. 13. As will be seen from Fig. 9, the ends of the lever are squared and screwed. The dimensions marked for the square part is $\frac{3}{4}$ in. This is, of course, for the end carrying the long lever, as well as the crank; the other end, which carries only a crank, will have the squared part only $\frac{1}{2}$ in. in length.

The cross-stay, C (Fig. 1), is simply to act as a guide to ensure the top chamber of the bellows rising and falling perpendicularly. It is secured to one pair of legs by rivets as the cross-stays are; it is made of 1 in. by $\frac{3}{8}$ in. iron bar, swelled out and bored in the centre, as shown at Fig. 4, to allow the guide-rod, F (Fig. 1), to slide easily through it. The upright guide-rod and square plate are shown in Fig. 7. The rod is of $\frac{1}{2}$ in. round iron rod, and the plate is countersunk for four screws, with which to attach it to the top board of the bellows, the rod being riveted into the square plate. The bellows, E (Fig. 1), are fastened to the frame by four stout wood screws, one through each leg. Between the legs and the centre board of bellows are placed four pieces of $\frac{1}{2}$ in. iron pipe, about 1 in. long; the four screws pass through the legs into these pieces of pipe, and are driven home into the centre-board of bellows, holding them quite securely.

The bottom chamber of the bellows is supported by four links, shown at G, G, G, G (Fig. 1).

Each end of these links is swelled out and bored (as shown in Fig. 10) at the bottom ends to fit on the round ends of two flat bars running across the bottom board of bellows (shown in Fig. 6), and at the top ends for the reception of the $\frac{3}{8}$ in. bolts, which connect them to the short crank, L (Fig. 1.) This arrangement is better seen at Fig. 14, L being the short crank, G, G the links, and Z the $\frac{3}{8}$ in. bolt and nut.

The flat bars just mentioned, and shown at Fig. 6, are made of 1 in. by $\frac{3}{8}$ in. iron bar, and are drawn out to a round section at the ends, and screwed for nuts, which keep the links in their place. They are fastened to the bellows' bottom board by three screws in each, passing through holes drilled and countersunk to receive them.

The Bellows.—We must now consider the construction of the bellows proper. These are composed of three circular boards of inch stuff, $14\frac{1}{2}$ in. in diameter. The middle and bottom boards are provided with valves, one in each opening upwards. These are made by drilling a hole, 2 in. in diameter, in the centre of each of the two boards. Over each of these holes is placed a flat, circular piece of leather nailed to the board at one side, so as to be free to move up and down for the passage of the air. A piece of wood is glued on the top of the leathers, to ensure dropping down flat and closing the valve when the air is within.

A wire stop, s (Fig. 6), is driven into the board, to prevent the wood valves turning completely over, in which case they would not again close when required. The top drawing in Fig. 6 shows a cross section of valves and bellows.

The middle board has a block of wood fastened to it, as shown in Fig. 6. This is for the reception of the screwed end of the pipe conveying the blast from the bellows to the hearth.

The three boards are fastened together by a piece of leather 14 in. wide, which goes all round them, and is securely nailed to their edges by 1 in. clout nails, placed in two rows, and as near together as possible. A strip of leather, 1 in. in width, is placed round the edge of each board over the leather covering, and the clout nails are driven through this and the leather covering into the boards. Before fixing the leather on to the boards, we shall have to insert four iron rings, made of $\frac{1}{4}$ in. round iron bar, $14\frac{1}{2}$ in. diameter outside, two in each chamber. These are to keep the leather stretched outward, and to ensure it forming even creases when opening and closing. The two ends of the circular band of leather covering the bellows should be joined with copper rivets and washers, such as are used for leather hose. These should be put as near together as possible.

The pipe leading the blast from the bellows to hearth is of $\frac{3}{4}$ in. iron tube, and is shown in section, with its fittings, in Fig. 8. It is screwed at the bottom into the wood block, T, and at the top into the air-nozzle, J, through the iron band encircling the hearth, with a back nut and washer to keep it secure. The air-nozzle should be of very thick wrought iron, and tapped to receive the end of the $\frac{3}{4}$ in. tube as shown.

The leather of the bellows covering should be of thorough good quality, and may be obtained at any currier's. It is scarcely likely that a piece will be obtained sufficiently large to make it in one piece, so that it will have to be joined with copper washers as described.

Our forge is now complete, and it only remains to regulate the flow of air by putting weights on the top board of bellows. Weights should also be suspended from the bottom boards sufficient to draw the lever up when pressed down. We shall now have a thoroughly substantial hearth if the above directions have been faithfully followed. Of course, the measurements may be varied to suit the maker, and it could even be made of lighter material; but, owing to the great amount of knocking about such a hearth will have to sustain, it will be best to keep as near as possible to the dimensions given.

Should any further help be required, the writer will be glad to give it through the medium of "Shop."

HOW TO MAKE A QUARTER HORSE-POWER STEAM ENGINE.

BY F. A. M.

The Feed-Pump and Governor—Conclusion.

Why Pumps will not Work—How a Feed-Pump should Not be Made—Spanners and Nuts—The Governor, Bracket, Sleeve, and Mitre-Wheels—Turning the Bolts—Fitting Arms—Throttle-Valve and Case—Adjusting Spring and Sizing Driving Pulleys—Stauffer Lubricators—Lagging of Cylinder—Making Steam Joints—Foundation of Engine—Driving Belt.

A word needs to be said as to the design of the pump. Many pumps fail, or give trouble, on account of the presence of air inside. When the plunger is drawn up this air expands, but no water rises into the barrel; when the plunger comes back the air contracts again.

Several drawings of feed-pumps have been recommended in mechanical publications, which are open to such an objection: Fig. 57 will make this quite plain. Here the plunger is much smaller than the pump-barrel, leaving a wide annular space round it; when air gets into the pump—as it is sure to do with the water—it will, of course, rise to the top, and the upper part of the barrel at *b* will be full of air, whilst any water there may be will lie at the bottom, as seen in the sketch. Now, when the plunger is raised the air will expand, and the exhaustion will be so little that it will be insufficient to raise the suction-valve and the column of water beneath it, and the consequence is the pump will not "draw." The usual remedy for this is to place a pet-cock at *a* to let out the air, but the proper course would surely be to place the passage to the delivery-valve at *a*, because then the air would be the first to leave the pump; also the superfluous space at *b* should be filled up. Turning now to our pump, it will be seen the delivery-valve is

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on the highest point of the inside of the pump, so that the air may be got rid of first. If anyone wishes to know where the air comes from, let him place a glass of water under the receiver of an air-pump, when he will quickly discover it comes from the water, being held in solution at atmospheric pressure, and boiling out as soon as the pressure is diminished. The valves are arranged to have a lift of $\frac{1}{16}$ in. When a valve of this sort lifts a distance equal to a quarter of its diameter, then the annular space opened under its edge is equal to the area of the valve. By this rule the lift of the smallest valve should be $\frac{1}{64}$ more than $\frac{1}{16}$ in., but it is well to allow a small lift; in the case of the upper valve, which must of necessity be of larger diameter, there is sure to be sufficient passage, and the lift might be rather less than $\frac{1}{16}$, which will diminish the shock and noise at each closure. Water confined in a pump or pipe is so incompressible that it must be considered almost as a solid; were the plunger of the pump to meet in the middle of its stroke a solid piece of heavy metal, there would be a thump and a shock; just such a shock may be expected in a force-pump, when the plunger, having filled up the empty space left in the body of the pump after the up-stroke, meets the column of water in the feed-pipe, and drives it a few inches further on. To prevent this shock, a cushion of air is provided in an air-vessel, and, instead of mounting a separate air-vessel on the top of the valve-box, the valve-box itself is prolonged upwards a little way, so as to imprison a small quantity of air above the delivery branch, which, by its elasticity, acts like the spring of a buffer to prevent a sudden shock to the passengers.

Spanners and Nuts.—With Fig. 5 (page 260) are shown two double-ended spanners; the larger one has an octagonal jaw at the large end, and it is intended to fit both the piston-rod and pump plunger-glands to tighten them up. The smaller end of this same spanner is hexagonal, and is intended to fit the gland of the slide-valve rod and the union-nut on the delivery branch of the pump, as also the hexagon upon the cap of pump valve-box. The smaller spanner fits all the other nuts about the engine except one; there are two sizes of them, for screws of $\frac{1}{4}$ in. diameter and $\frac{5}{16}$ in. The nuts, if made at home, should be carefully kept to the same size; and if bought, they should be obtained, all of them, from the same firm. They would be best of steel, hardened, as also the spanners, and spring-tempered, or let down to a blue, or simply "blazed off"—that is, hardened in oil; and then, while the oil is upon them, held in the flame till the oil "flashes," and then quenched. This leaves them hard enough, yet tough. This hardening will leave them black, but they will look very well so, forming a pleasing contrast with the bright work. The spanners may be made as steel forgings by the nearest smith. Saw out a pattern of fret-wood for him to work to. File up a tin template for gauging the large one, to get it the exact size; file the small one to fit the nuts, then harden and temper them both.

We may now undertake the construction of the governor. It appears in Fig. 4 and Fig. 6, but the details are best seen in Fig. 24 (page 328). The old Watt governor, as in old engines and text-books, has six joints; this one has but two. The newer forms of governors have a spring on the spindle or shaft, and some of them scarcely look like governors at all. The form here given has something of the orthodox look without the troublesome six joints; it will work as it is, or may have springs attached if desired. The only difficulty connected with this form of construction is the tubular spindle, $3\frac{1}{2}$ in. long, $\frac{1}{4}$ in. diameter, with a $\frac{1}{8}$ in. hole through it. This may be made from a bit of round steel, bored through, and then turned true with the bore; but steel tubing of this size can be obtained.

We will begin with the main bracket by bolting it upon the angle-plate upon its side, and after boring it through with a $\frac{1}{4}$ in. drill, turn the recess in the top which holds the oil and the rounded bead on the edge. Now turn the casting round upon the angle-plate and bore the long boss, also with a $\frac{1}{4}$ in. drill, and face the end. Take the brass casting for the body or sleeve of the governor, with the two arms on it; hold it in a universal chuck, and bore it with a $\frac{1}{4}$ in. hole. Now take the steel tube and put it between the centres of the lathe to get it perfectly straight by bending; when it runs quite true, try it into the standard or body, and reduce it by turning or simply by filing till you can drive it firmly in; then it will not need the little round pin, seen at the top, for securing the two together. Now turn the outside of the body, and then reduce still further the lower half of the tube till it will turn easily in the bracket, carefully squaring up and smoothing the bottom surface of the brass body where it rests and turns upon the top of the standard.

The little mitre-wheel underneath will be the next to fix. The under-side of the hole in the bracket would be first filed up square for the wheel to work against, and then the wheel may be fixed by the pin, as shown. This pin cannot go through the middle, because of the little $\frac{1}{8}$ in. rod which slides inside the tube. The wheel may be keyed if that be thought easier, or it might be fixed with a pinching-screw. These mitre-wheels can be bought ready-made for one shilling each.

Now take the governor-balls, 1 in. in diameter; fix a bit of sheet metal into a wood chuck, and bore an inch hole in it; then cut it in two, and it will serve as a template to guide you in turning up the balls. The template should be so cut that it will give you one exact half-circle. If these balls were for ball-valves, we should have to be most particular in turning them, and it would be necessary to make a special tool, but in this case we may proceed as follows:—Chuck the balls by driving them into a recess in a hard wood chuck till very slightly more than the half diameter projects; turn the projecting part to an exact half-sphere, using the template to test it; then bore a hole in the middle of the ball, and tap it ready to screw on to the arm. When both the balls have been treated so, alter the chuck so that you can fix them in the opposite way up to the shoulder left by the turning, so that exactly the half-sphere will now be contained within the chuck; now turn the projecting portion true to the template; if the template is exactly the half circle, and you are tolerably careful, you will not be far wrong. Of course you can re-chuck the balls at different angles and reduce the error, but I think for this purpose it would be unnecessary. There should be a small hole through the back of the wood chuck to drive the balls out by, and a little screw may be made on any bit of steel held in the lathe, on which to mount the balls to polish the whole of the outside. Now take the arms on which the balls hang, centre them and turn them up, cutting the screws to fit into the balls. The shoulder against which the balls screw is a collar $\frac{1}{4}$ in. in diameter, and that is just the thickness of the joint at the other end. File the flat of the joint parallel with the arms, laying them down sideways on the face-plate to try it, and file out the slot which forms the joint in the arms of the body of the governor. The file can be passed through both arms (see Fig. 27), so that it is easy to file out these two joints and make a perfect fit. The arms of the governor carry small levers at an angle of 120° with the longer part of the arms, which short arms or levers meet in the centre, in the slot of the brass piece which forms the top of the governors, and are halved together in that slot. The shape of one of these small levers is seen projected above (Fig. 24), and the top piece with slot at Fig. 26. This little piece is pinned on to a $\frac{1}{8}$ in. steel wire, which passes down the centre of the governor and revolves with it, but can be raised up or down $\frac{3}{8}$ in., according as the balls are hanging down or flying out. Upon the lower end of this steel wire is pinned another piece of brass, in which is turned a deep groove; in this groove enters the forked end of a small lever, clearly seen in Fig. 25, which lever is also shown projected above; it is secured to a piece of $\frac{1}{8}$ in. brass wire, which passes straight through the gland of the throttle-valve (see also Fig. 28). The lever might have upon it an arm, as dotted, with an adjustable weight for regulating the speed at which the governors would control the engine within small limits. But if our engine is simply required for driving a lathe, etc., in an amateur's workshop, a high degree of regularity will not be required.

The wire which controls the throttle-valve is made of brass, because, like the pump and its plunger, it would be liable to rust if it were of iron, and that would cause unnecessary friction in the stuffing-box. This stuffing-box is clearly seen in section in Fig. 25. It requires to be carefully packed and screwed up as lightly as may be, only just enough to prevent the escape of steam. It would be very easy to screw it so tight that the governor could not rise at all, and would have no control whatever over the engine.

Coming now to the throttle-valve and its case, shown separately at Fig. 28, it may be held in a universal while the oval flange is faced; then the holes for the bolt might be made through this flange, and then it could be clamped by the flange upon a face-plate, the hole inside bored out true and smooth, the screw-thread cut (gas thread) to fit the stop-valve, the shoulder faced, and the edge turned bright. It is supposed that a stop-valve would be bought, and not made. It will cost about four shillings. A $\frac{3}{8}$ in. stop-valve is large enough for this engine, and $\frac{3}{8}$ in. piping for the steam-pipe; but $\frac{1}{2}$ in. would be better for the exhaust. That being the case, it will be simpler to have both steam and exhaust $\frac{1}{2}$ in. bore, and then the stop-valve must be $\frac{1}{2}$ in. too. A $\frac{1}{2}$ in. stop-valve is shown at Fig. 4. There will be required a $\frac{1}{2}$ in. "nipple" to connect the stop-valve with the standard, since both these have female threads. A "nipple" is a short ferrule of pipe with threads on the outside; it would be screwed firmly into the standard, and the stop-valve would screw upon that. The throttle-valve case, or standard, may be mounted upon the angle-plate chuck to bore and tap the stuffing-box, which is to be done at an angle of 45° with the flange. The casting for the throttle-valve itself appears at Fig. 29. It will be

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centred and turned till it will fit into the bored hole in the standard. The hole for the brass wire which carries and controls it may, perhaps, best be bored by placing the valve in position in the case or standard, and then passing the drill in through the stuffing-box and gland. Next, the governor standard would be fixed and screwed down in position, and the hole for the other end of the brass wire bored through the arm of the bracket made to sustain it, when the wire would be put through that arm and the stuffing-box of the throttle-valve standard, while the latter was placed in position on the valve-box. Thus arranged, the holes through the oval flange could be correctly marked upon the steam-chest. The stems cast on the throttle-valve to aid in turning it may now be cut off, and the hole through valve and wire drilled, and the little brass pin, seen in Fig. 28, inserted. All that is required now to complete the connection between the governor and the throttle-valve is to make the little lever which embraces the grooved piece at the bottom of the small rod which passes down the centre of the governor. Now fit the shaft in the long boss, bore the small pulley which receives the band, drive it on at one end, and turn it up in position; bore and fix the little mitre-wheel at the other end, adjusting it to gear to the correct depth, and fixing it with a key or a pin driven right through.

It must not be supposed that the throttle-valve will stop the steam without any leakage: it could not do so fitted in this way; the stop-valve will do that; but the throttle-valve will stop nearly all passage of steam, and when closed by the governor there should not be sufficient leakage to work the engine. The parts of the governor are so proportioned as to allow the engine to run at about 100 revolutions per minute. The pulley on the horizontal driving shaft is the same size as the groove in the boss of the eccentric, so that both engine and governor would run at the same rate. If it were desired to make the engine run twice as fast, that could be done by replacing the pulley on the horizontal shaft by one of twice the diameter, so that the governor would still turn at the same speed, while the engine was going twice as fast. It would increase the power of the governor to work the throttle-valve, if it were allowed to run at 200 revolutions whilst the engine made 100; to do this we might make a brass or hard-wood pulley of 3 in. diameter, and key it upon the boss of the eccentric, over the present groove; then a spring or weight would have to be so arranged as to bring down the arms of the governor, when making 200 revolutions, to their normal, or midway, position—the one they now occupy when revolving at 100 revolutions. A weight could be arranged as shown dotted in Fig. 25; and springs might be applied as shown sketched at Figs. 58 and 59. It is not proposed to show how to calculate the spring or the weight, because it is a very easy thing to test the governor by spinning it, counting the revolutions, and then making the pulleys to the correct size. In Fig. 58 it is supposed that four small eyes are screwed into the centre of the balls on both sides, so that a couple of springs can be fixed to draw the balls together. A neater plan is shown at Fig. 52; here two notches (*n*, *n*) are filed in the knuckle of the governor arms, into which enter the ends of the bow spring (*s*); these ends are kept in place, sideways, by the slot in which the arms move, whilst the middle of the bow is pierced with a small hole, and passes over a small pin (*p*) screwed into the lower part of the little ball, the upper part of which has been cut away. Supposing it be decided to use a spring, a little flat one of this kind would be very easy to make and apply; the pulley on the horizontal shaft of the governor could be driven off a groove on a chuck in the lathe, then the governor could be spun till the arms took up their midway position, when the revolutions would be counted; if the rate were evidently too great, the spring would be taken off, and weakened by grinding it a little thinner. When the arms of the governor come to the mean position at about 250 revolutions, the adjustment would be correct. It would be well also to ascertain what speed is required to raise the arms to their highest point and close the throttle-valve, and, again, at what speed the arms begin to rise; we might expect to find 240 revolutions would raise the arms, 250 bring them half-way up, and 260 raise them to the highest point; then, if the engine is speeded to run at half the revolutions of the governor, it may vary in speed from 121 to 130 revolutions per minute, but would not in practice vary more than ten revolutions, except under exceptional circumstances. It might be impossible to count the revolutions of the governor, but it would be easy to count the lathe mandrel, and the groove on the chuck could be made twice or three times the size of the pulley on the governor shaft.

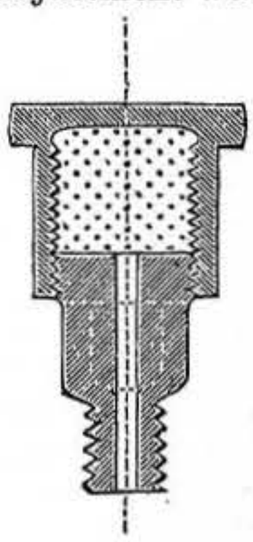

Fig. 60.

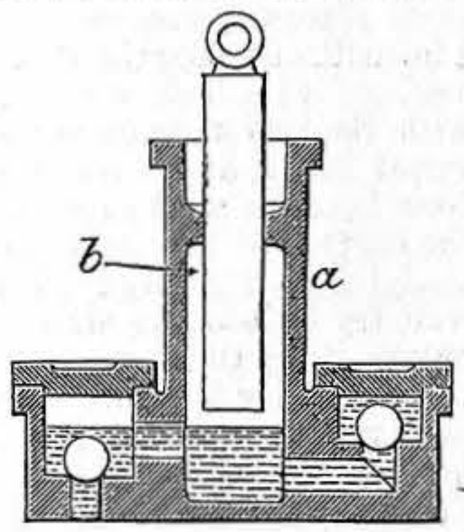

Fig. 57.

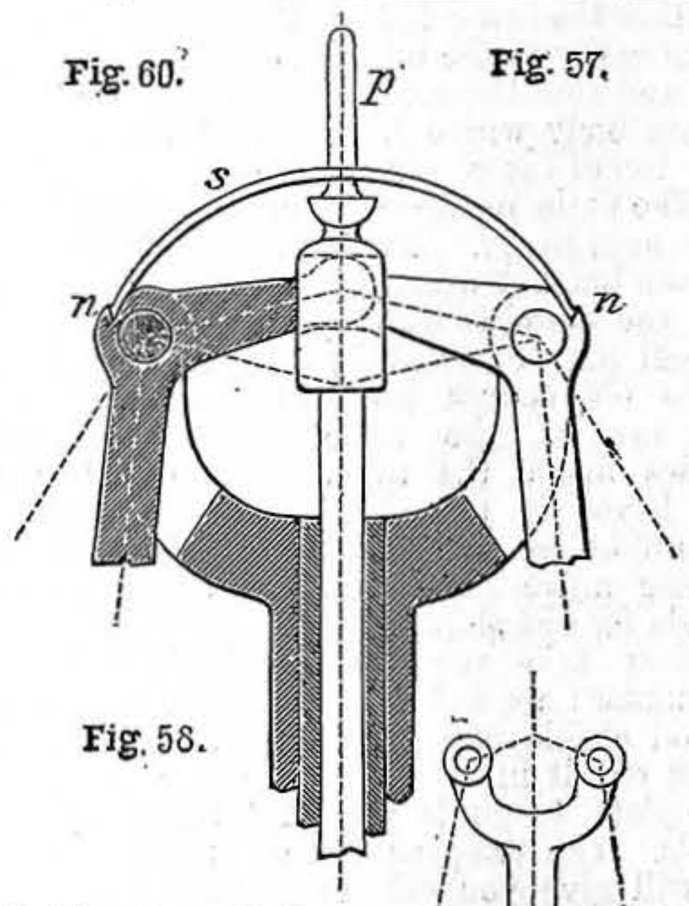

Fig. 58.

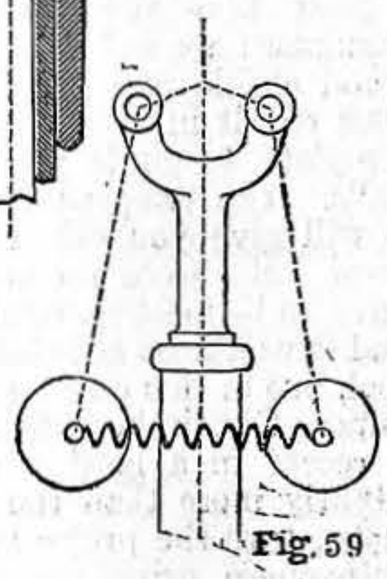

Fig. 59

Fig. 57.—How a Feed-Pump should not be made. Figs. 58, 59.—Two Methods of applying Springs to Governor. Fig. 60. — Section of Stauffer Lubricator.

I cannot say, certainly, that our engine with such a governor as we have now described would be sufficiently steady to drive a dynamo: I think it would; and with a good boiler, large enough to run the engine at 200 revolutions, I am led to believe it would light about six lamps of 10 candle-power.

Lubricators.—Something must now be said about the lubricators. These, it will have been noticed, are not of the usual kind; should anyone wish to use the common kind of oil cup, they can of course do so, or they can do without any cups. The ordinary oil cup, however, requires to be set in a vertical position, which these do not. The lubricators shown in our engine are the smallest size of Stauffer's patent lubricator, and cost one shilling each. They are filled with a kind of grease which looks like yellow cold-cream. A section of one of the lubricators is seen in Fig. 60. It consists of two parts: a cap, which is filled with the grease, is screwed down upon the other part till the grease is forced down the small hole into the bearing; as the shaft revolves it distributes the grease, which soon begins to ooze out at the sides of the brasses; the bearing is then ready for work, and will require no further attention for a day or so, or even, perhaps, for a week; even when a fresh supply of grease is required, it is only necessary to give the cap about half a turn with the fingers, so as to force out a little more grease into the bearing; when the cap has been screwed quite down it must be re-filled. No oil runs or drops about to make a mess, and nothing could be cleaner or more convenient. This form of lubricator can be used in any position: it may be horizontal, as on the eccentric and connecting-rod; it may force grease into several rubbing surfaces at once, as that on the top of the cross-head; it may be placed upside down, or it may revolve with the boss of a loose pulley. No lubricator has been provided for the slide-valve and piston, because when working at moderate pressures the water contained by the steam lubricates sufficiently. A simple way to lubricate both slide-valve and piston at once is to arrange an oil cup so that it may deliver into the steam-pipe; by thus lubricating the steam-pipe, the oil is carried to all the rubbing surfaces inside.

The exhaust-pipe is supposed to be simply screwed into the cylinder casting: it leads downwards, to carry off the water; it may be led down towards a drain and a hole made at the lowest point there, to allow the water to escape; after which it may turn upwards to carry the bulk of the exhaust steam into the air.

Cylinder cocks are shown to carry off the condensed steam from the cylinder; they are opened at first starting the engine, when the cold metal of the cylinder condenses a good deal of steam; they are both moved by one handle. These taps cannot really be considered necessary on such a small engine, especially with a descending exhaust.

All drips or leakage about the engine should be prevented as far as possible. Engines are often seen working without the slightest whiff of steam appearing even at the stuffing-boxes. It would be very undesirable in an amateur's workshop to have an escape of steam, as it would be liable to rust the bright work about the lathe, tools, etc. The stuffing-box of the stop-valve is liable to leak, and this valve-cock should be screwed on the right way up—that is, in such a way that when closed the steam should be shut off from the stuffing-box. A little tin tray may be hung by a wire under each stuffing-box gland, so as to catch any

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drops that may fall; the pump gland is one especially liable to drop and make a mess.

Lagging of the Cylinder.—The "lagging" or wood casing surrounding the cylinder appears in Figs. 4, 5, 7, and 25; it is useful in two ways: first, it prevents loss of heat from the cylinder, and consequent loss of power; and secondly, it prevents the engine from unduly heating the apartment in which it works; also it looks well if nicely fitted, the wood polished, and the brass bands kept bright. The cylinder would first be clothed with felt or, say, part of an old blanket; then the wood lagging in strips of mahogany; and then the brass hoops secured as seen in Fig. 7; or, otherwise, instead of the hoops there might be a piece of thin sheet metal bent round the wood and painted.

Steam Joints.—Making the steam joints is a very simple thing. Buy a little red-lead powder and some white lead (in paste) from the ironmonger or colourman; mix a little red-lead powder into some white lead just to stiffen it, work it well together, and rub this on to the threads of the screws of the pipes before screwing up. It is usual to spread some of this same cement between the flat surface joints, such as those of the cylinder cover, valve-chest, etc., but I have used a piece of red blotting-paper with complete success. It was cut out with holes for the bolts, and when cut round the edge of the joint, looked as if it were a red-lead joint, with the advantages that you could take it apart as often as you wished, whilst none of it squeezed out of the joint into the inside of the cylinder. It would be an advantage to oil the blotting-paper before screwing up the joint.

Foundation.—There are three lugs provided on the bed-plate, by means of which the engine can be bolted down upon a foundation. The foundation may be a frame of wood made so as to raise the engine high enough to allow the fly-wheel to run clear of the floor; or it might be a stone, the foundation bolts being fastened in with lead. It is convenient and suitable to have the engine raised above the floor, at any rate as high as a chair, because it is more easily got at. When not at work, it should be carefully covered with a cloth or piece of green baize, to keep it from dust and damp, remembering that dust and grit, and above all emery-dust, must not be allowed to get on to the sliding guide nor into the bearings.

Driving Belt.—The fly-wheel, being 16 in. in diameter, a flat belt round this wheel should transmit all the power the engine is capable of exerting without being unduly tightened. It is well to arrange for the belt to run upwards, because then it may relieve the bearings of most of the weight of the fly-wheel; and it is better, if the belt must be inclined upwards, to arrange it to incline forwards, from the engine, not backwards, towards and over the engine; because, in the first case, the pull of the belt would tend to cause wear upon the middle of the upper brass of the crank shaft bearing, which wear can be taken up by tightening the cap of the bearing; but in the second case the wear would come upon the sides of the brasses, where they are divided, and here the wear cannot be taken up.

I will now take leave of my readers, heartily wishing them good success.

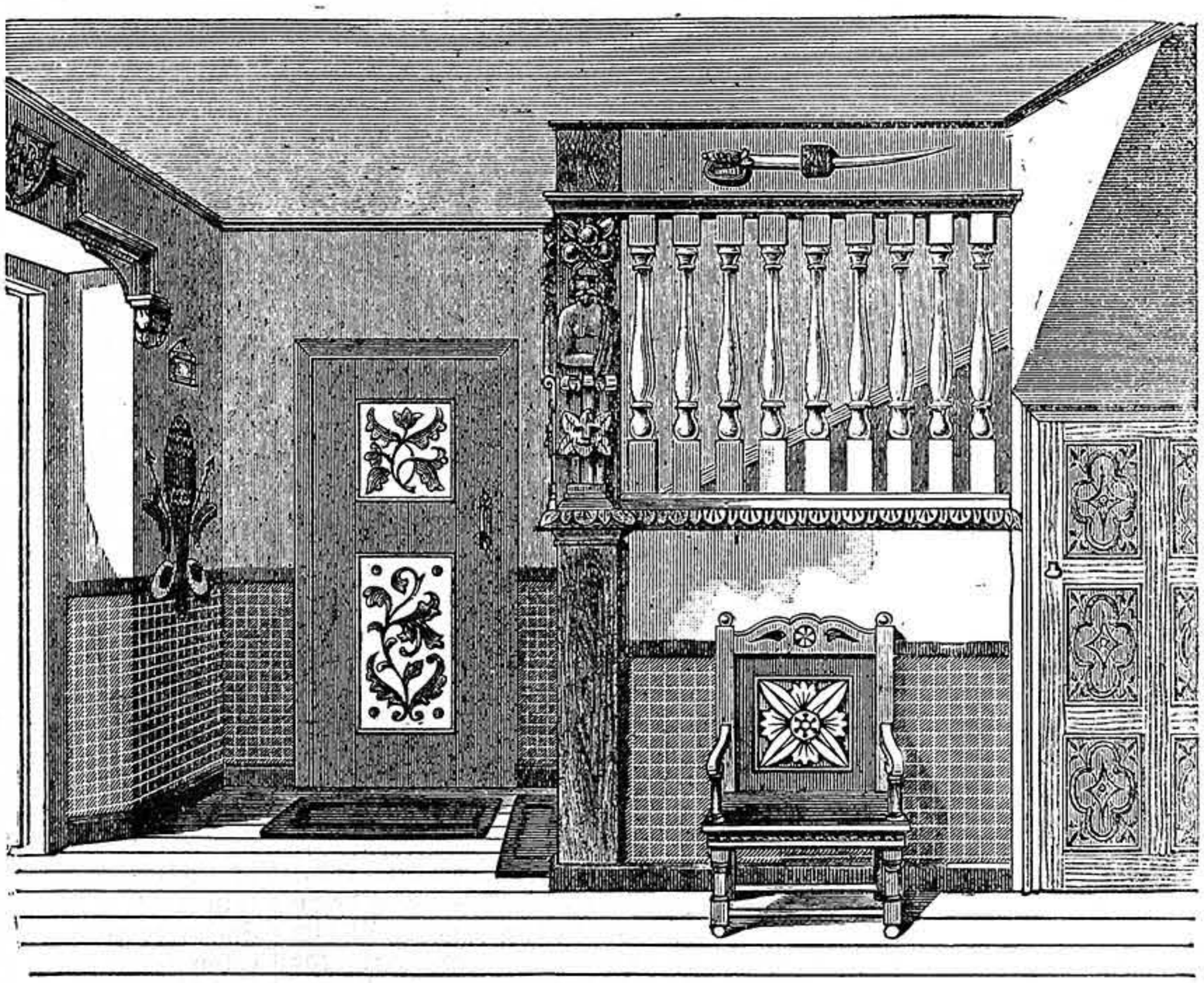

Fig. 16.—The Entrance Hall as re-arranged, showing Staircase.

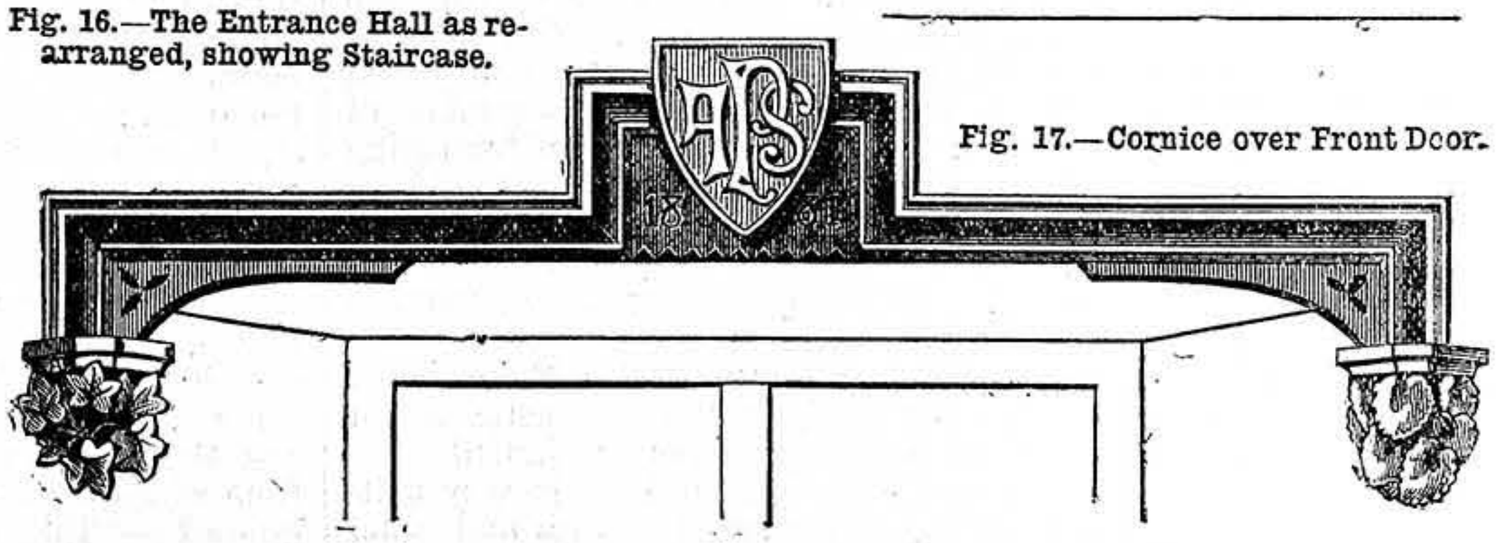

Fig. 17.—Cornice over Front Door.

MAKING THE BEST OF A BAD HOUSE.

BY MARK MALLETT.

THE ENTRANCE HALL—THE STAIRCASE—THE FRONT DOOR—THE STUDY DOOR—THE WALLS.

The Entrance Hall.—All those among us who find pleasure in the tasteful arrangements of our homes are, I believe, of one mind as to the desirability of having an entrance hall deserving of that name, and one which can properly be called by it. Comparatively few, however, of those who, like myself, are not born to fortune, can indulge in the luxury, for the majority of small houses have, instead, nothing better than a miserable passage. Fortunately, in my house I found a real hall, though but of small dimensions. It was not passage-shaped, but almost square, viz., 12 ft. by 11 ft. On each side of it was a door—westward to the public street, northward to the study, southward to the dining-room, and eastward to a parlour (for it seems absurd to dignify this little apartment, scarcely more than 12 ft. square, with the title of "drawing-room"). The stairs also rose from it, and, indeed, much of the northern side was occupied by the lower part of the staircase.

The Staircase.—When I entered upon the house this same staircase was by no means a sightly feature. It was, in its lower part, completely enclosed: at its side it was shut in by a lath-and-plaster partition, and at its foot by a door. It thus detracted from the apparent size of the hall, and prevented its giving a due impression of its shape. As for the stairs themselves, they were of bare elm board, strong, certainly, and sound, but bleached with the soft soap and scrubbings of a long course of years. They looked unpromising, but elm is always a hopeful kind of wood: under proper treatment it will generally develop a pleasing grain and a good colour. Accordingly I brushed them over with hot boiled oil, so far as they would not be covered when carpeted, and polished them with bees-wax and turpentine. I found that they repaid my trouble.

The door at the stair-foot I cleared away, and removed all traces of it. A reference to Fig. 16 will show in what manner I dealt with the partition at its side. To have removed this partition bodily, and substituted a balustrade, would have been too serious an undertaking for me, nor did I see any pressing necessity for so doing. Among other wreckage of "restored" churches, I had secured a set of discarded communion rails, which were good solid oak-work of the seventeenth century. I cut out a portion of the partition, as shown in Fig. 16, and in the opening inserted a length of this railing. For the remaining portions I found employment as balustrades on the landings of the two upper storeys, where some shabby painted deal rails had to be removed. Of the alteration in the

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entrance hall, I may say that it sufficiently lights the previously dark stairs, and throws the staircase open to view; moreover, its quaint and unusual appearance renders it, to my thinking, more pleasing than a regular balustrade could have been.

As with the new arrangement the post at the stair-foot had a somewhat bald appearance, I looked through my stock of old oak carvings, and found two demi-figures, which I nailed upon it in the manner shown in Fig. 16.

Beneath the staircase was a closet opening from the hall by a shabby painted door. This door I also took away, and substituted for it that which appears in the illustration (Fig. 16). The carving seen upon it is of the same kind as that on the dado of the study, though of a different pattern, and is my own work. The door itself is of old oak panelling of the time of James I. The view of the staircase in its present form (Fig. 16) is as it appears through the open door of the dining-room.

The Front Door.—The opening to the street door as seen from within was by no means pleasing. It was of considerable width, the walls, which were very thick, being splayed away inwards; and I had to consider how, whilst improving its appearance, I might also arrange for the hanging of a heavy curtain during the winter months. Fig. 17 will give some idea of the plan adopted. The cornice there shown is made from a bold steam-struck moulding (of which it will be presently seen I used more elsewhere), and which, like the board to which it is attached, is ebonised. On the scutcheon in the centre I emblazoned my monogram on an azure ground. The curtain itself is not there, nor is the rod shown by which it may be hung. This is another fragment of the wreck of the four-poster, on which it once figured as the foot-rod. Like its fellows in the "den," it is enamelled vermilion. The cornice is made to rest on two corbels, which were cut by me from the soft stone of the country (white lias), and which are let into the wall for that purpose.

The Study Door.—I have mentioned that the study had old-fashioned ledger doors—doors of plain boards nailed upon cross-pieces—and as the other doors which opened from the hall were panelled, that to the study, which was close by the stair-foot, looked out of keeping in its original state. Accordingly, with some strips of narrow moulding, I marked out two panels; throughout their length I carefully puttied up the central chink, and upon them I painted in monochrome a sort of conventional foliage scroll, as shown in the illustration. The panels are of a Pompeian red; the other parts of this and the other doors black.

The Walls.—These I contented myself with papering with a dado paper; and, in the absence of any other cornice round the ceiling, I fixed up one of ebonised moulding similar to that in the study, namely 1¼ in. deep; but, as will be seen from the illustrations, I arranged no frieze here.

My entrance hall being thus reorganised, I furnished it with a small, dark, carved oak table, and two ancient carved chairs, one of which shows in Fig. 16. Its walls were now no unsuitable place round which to hang antique weapons, scraps of carving, fragments of armour, and such like curios which men of the tastes of its owner ever find delight in accumulating, and which are as appropriate in this position as old china, bits of bric-à-brac, and Japanese fans, and screens and other fanciful means of ornamentation are in the drawing-room.

PRACTICAL PAPERS FOR SMITHS.

BY J. H.

TEMPERING MIXTURES: WATER—MEDICAMENTS—OILS AND FATS—LEAD BATHS—HARDENING BETWEEN COLD METAL—FICTION *v.* FACT—EXTREMES OF TEMPER—EXAMPLES—TAPS—DIES—DRILLS—MILLING CUTTERS—AXES—MILL PICKS—SPRINGS.

My remarks in this article will have reference to the different kinds of tempering mixtures used, and the special treatment adapted to various tempered articles. Owing to pressure of business I have not been able to send in these "Practical Papers for Smiths" as quickly as I could wish; I shall, however, do my best to complete the section of my subject selected for treatment in the present volume of WORK in two more short papers.

Tempering Mixtures: Water.—Water is the commonest medium used for quenching steel, and hard water is not so suitable for tempering as soft or rain water. Moreover, smiths do not change the water in their tempering tanks, but simply add fresh in sufficient quantity to make up for waste. They have an opinion that water which has been long used is preferable to fresh water. It is supposed that the virtue attributed by smiths to that which has been long in use may be due to this: that the frequent warming of the water by red-hot metal has driven off the air contained in it, and allows the fluid to come into more intimate contact with the surface of the steel than when normally impregnated with air. The belief that boiling the water is beneficial may be explained in the same way.

Pure cold water is very commonly used for ordinary tools, such as chisels and drills; but for other and more difficult work, warm water, or water medicated with various substances, is found more suitable.

Medicaments.—Thus, a good tempering bath is made by adding half a pint of common salt to a gallon of soft water, and brine of various degrees of saltness is one of the most favourite mediums employed for quenching tools. But many other salts are also extensively employed. The salts of potassium, ammonia, mercury, and boron are in much request. Ferro-cyanide of potassium is frequently used in tempering baths, along with salt and borax. About half a pound each of potash and borax, and about six ounces of salt, pulverised and dissolved in ten gallons of water, make a good bath.

But the hardening effect of water is too intense for many classes of articles, for which oils and fats are better adapted.

Oils and Fats.—Linseed oil is very suitable for tempering small springs and other articles in. Beef suet, grease of various kinds, refuse of fats and oils, used alone, or mixed with pitch and resin in various proportions, are also used for spring steel.

Lead Baths.—A bath of molten lead is a good heating agent for many articles up to the temperature for tempering. In it also articles of unequal thickness can be heated uniformly. The lead is prevented from oxidation by covering its surface with powdered charcoal.

The temperature of a bath of pure lead is of course uniform, but by making alloys of lead and tin in various proportions, an extensive range of temperature is obtainable, suitable for work of different classes. The following table, taken from Dr. Percy's "Metallurgy of Iron and Steel" (p. 854), will serve to show what can be done by means of such tempering baths of alloy:—

TABLE OF THE COMPOSITION OF METALLIC BATHS FOR THE USE OF WORKING CUTLERS.

No.		Composition of the Bath.		Temp.
		Lead.	Tin.	Fah.
1	Lancets	7	4	420°
2	Other surgical instruments	7½	4	430°
3	Razors, etc.	8	4	442°
4	Penknives, and some implements of surgery	8½	4	450°
5	Larger penknives, scalpels, etc.	10	4	470°
6	Scissors, shears, garden hoes, cold chisels, etc.	14	4	490°
7	Axes, firmer chisels, plane irons, pocket-knives, etc.	19	4	509°
8	Table-knives, large shears, etc.	30	4	530°
9	Swords, watch-springs, etc.	48	4	550°
10	Large springs, daggers, augers, fine saws, etc.	50	2	558°
11	Pit saws, hand saws, and some springs	Boiled linseed oil.		600°
12	Articles which require to be somewhat softer	Melting lead.		612°

Hardening between Cold Metal.—It is not even necessary that hardening should always be done in liquid. If a thin heated plate is placed between two pieces of cold metal, it will become hardened as effectually as if in water or oil. This is often done, because it tends to lessen risk of warping of the plate.

Fiction v *Fact.*—It may be suspected that many of the various medicaments employed in hardening mixtures, and the use of so many different proportions of oils and fats, are more fanciful than valuable—more of the nature of supposed trade secrets than of vital importance. This may be the case in some instances, but I doubt if it is often so. A workman finds that he can obtain certain excellent results by the use of such and such compounds, which he cannot, or does not, obtain by the use of any others. That man is always working in that line, and surely ought to know what is best. Tool makers often keep their knowledge to themselves, thereby giving the best possible proof of their belief in its value. It is also certain that a knowledge of the relative conductivity of many of the mixtures employed often fully bears out the wisdom of the smith's practice. Mr. Godwin Austin referred to this matter in an address delivered before the British Association in 1889. He remarked: "But cold water was far too simple a material for many a sixteenth century artificer to employ, as is shown by the quaint recipes contained in one of the earliest books of trade secrets, which, by its title, showed the existence of the belief that the 'right use of alchemy' was to bring chemical knowledge to bear upon industry. The earliest edition was published in 1531, and the first English translation in 1583, from which the following extracts may be of interest:—'Take snayles, and first drawne water of a red die, of which water being taken in the two firste moneths of harvest when it raynes; boil it with the snayles, then heat your iron red hote and quench it therein, and it shall be hard as steele. Ye may do the like with the blood of a man of xxx. yeres of age, and of sanguine complexion, being of a merry nature and pleasaunt . . . distilled in the middst of May.' This may seem trivial enough, but the belief in the efficacy of such solutions survived into the present century, for I find in a work published in 1810 that the artist is prettily directed to 'take the root of blue lillies, infuse it in wine, and quench the steel in it,' and the steel will be hard. On the other hand, he is told that if he 'takes the juice or water of common beans and quenches iron or steel in it, it will be soft as lead.' I am at a loss to explain the

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confusion which has arisen from this source. As must always be the case when the practice of an art is purely empirical, such procedure was often fantastic, but it is by no means obsolete, for probably at the present day there is hardly a workshop in which some artifice could not be found with a claim to possess a quaint nostrum for hardening steel. Even the use of absurdly compounded baths to which I have referred was supported by theoretical views. Otto Tachen, for instance, writing of steel in about the year 1666, says that steel when it is 'quenched in water acquires strength, because the light alcaly in the water is a true comforter of the light acid in the iron, and cutlers do strength it with the alcaly of animals;' hence the use of snails. Again, Lemery explains in much the same way the production of steel by heating iron in the presence of horns of animals." How much are modern theories nearer the mark?

But the belief, as old as Pliny—who maintained that the quality of steel depended on the nature of the water used in the process of hardening, and who mentions the use of oil for tempering where water would have too great a hardening effect—is still held and acted on by every smith in large factory and country forges, and is in the main correct, both in practice and theory.

It is not surprising that different men differ so greatly in their statements respecting the working of steel. Welding and temper depend for their efficiency not only upon minute differences in grades of steel, but also on the minute alterations of colour that indicate grades of temperature. Intensity of colour is a matter of individual opinion, and depends also on the light in which it is observed. A colour that looks bright in a dark shop or on a dull day will not be so bright under contrary conditions. Matters like this have to be borne in mind when endeavouring to reconcile statements apparently at variance. Much also depends on what previous hammering a tool has undergone. Hammering at a low red heat closes up the fibres and renders the steel better adapted to take a good temper. The thinner a tool, the more difficult it is to temper. The greater the length of that portion of a tool which is tempered as distinguished from that which is hardened, the better will be the temper. That is, if a tool is only dipped for a length of ½ in., and then let down, it will not be so reliable as one that is dipped 1 in. or 1½ in. There is no end of little matters that affect the ultimate temper of steel articles. A man may spend his whole life in such work, and still confess himself ignorant of many matters of an apparently occult character. For this reason, no one should dogmatise about the virtue of his own special methods to the exclusion of others, probably equally good.

Extremes of Temper.—In tools the maximum of hardness and elasticity combined is obtained by tempering at a straw colour. Quenching at a red heat makes a tool intensely hard, but brittle. Quenching at a blue makes it elastic, but soft. Between these extremes the whole practice of hardening and tempering lies.

I instanced the chipping chisel in the last article as a typical case of hardening and tempering; I will now refer to some other tools.

Taps.—Screw taps are conveniently heated in an iron tube, large enough to allow not only of the admission of the tap, but also of the tongs by which it is manipulated. The tap must be kept slowly revolving within the tube, in order that the temperature may be equally distributed throughout. The same method will be employed for heating the tap, both for hardening and for tempering. The tool is first hardened by heating to a dull red in the tube. The temperature must be raised gradually and very slowly, and equally throughout. If heated rapidly, the edges of the threads will be at a higher temperature than the interior, and being probably too hard, will crumble off in use. A dull red must not be exceeded; in fact, it must be an invariable rule to harden and temper taps at the lowest heat practicable. It is better to make two or three attempts, increasing the heat each time, rather than to rashly overheat at once and spoil the tool. It is then plunged vertically into lukewarm water, and held there until quite cold. Afterwards the flutes are brightened with emery and oil, and heated to a light straw in the tube, and quenched for temper.

Some use linseed-oil baths for quenching taps and dies. It is, however, a good precaution to use soapy water. Also the points of the threads may be protected with a coating of soft soap, or with a paste made of prussiate of potash and flour, or yeast.

The specific gravity of hardened steel is less than that of unhardened steel. Hardening, therefore, has the effect of slightly expanding the steel, and taps are screwed very slightly less in diameter than they are required to be after hardening. Other tools that are turned in the lathe before hardening, such as D-bits, fluted reamers, and rose-bits, are also for the same reason turned bare to size.

Dies.—Dies are first heated to a cherry red, and hardened in salt water. To diminish the risk of cracking, they are covered with prussiate of potash or with a paste of soap and oil. The faces are polished, and the dies heated on a hot piece of iron, taking care to turn them over and over until they are of a straw colour, dark, bright, or medium, according to circumstances. A bath of linseed oil may also be used for tempering.

Worn dies are not thrown aside, as a rule, but are re-cut. Before they can be re-cut, the temper must be completely drawn by annealing. This is done by heating the dies to a light cherry red in a clear fire, and covering them with sawdust and ashes until cold. Or they are enclosed in an iron tube, and heated with charcoal or leather cuttings, and allowed to cool. Other tools, such as broaches, milling cutters, reamers, and lip drills, when worn, are similarly annealed preparatory to re-cutting. Afterwards they are tempered just as in the case of new tools.

Drills.—Drills for cutting iron are tempered at a dark straw at the cutting edges. The remarks made in reference to the hardening and tempering of cold chisels in the last article apply equally to drills for iron.

Drills for boring hard steel will be heated and quenched in a lump of lead, and not drawn afterwards. Glass may be drilled with such tools by the assistance of paraffin or petroleum for lubrication, placing a cork underneath the glass beneath the drill to deaden vibration.

Milling Cutters. — Milling cutters are heated to a red, dipped into oil until the red colour disappears, and then transferred to water, and left till cold; then heated to a light straw, and cooled.

Axes.—Axes are hardened and tempered very much like chisels. They are heated first to a red, and quenched to a depth of two or three inches in water. A face is polished, and the changing tints observed until the appearance of a deep blue, at which total immersion is made for temper. As in other tools, different shades of blue, inclining towards a brown straw, will be required for different grades of steel.

Mill Picks.—Mill picks are not tempered in the common acceptation of the term, but hardened only. They are heated to a dark red, and quenched finally, the temper thus obtained not being drawn, or let down, as in the case with most of the tools already noticed. Pure soft water is quite suitable for these, and yet most smiths use medicated mixtures, into the composition of which salt, alum, sal-ammoniac, etc., enter.

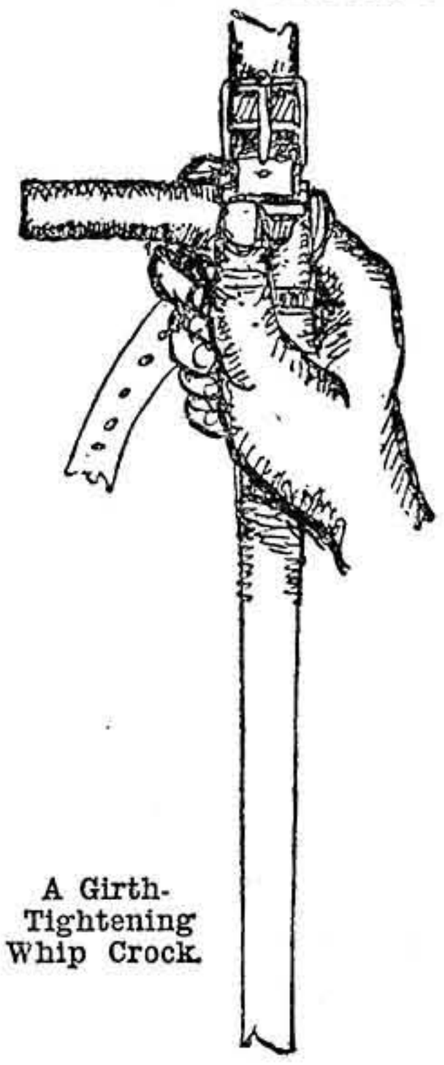
Springs.—Springs are first hardened in the usual way by heating to a cherry red, and quenching in water. Then they are smeared with tallow or lard, and heated in the fire or over the fire, moving them to and fro until the tallow catches fire, and blazes and burns off. When burned off, the springs are laid upon the forge, or on the ashes to cool down. If the work is of irregular thickness, the burning of the oil should be repeated two or three times.

Small springs made in quantity are often put into a sheet-iron pan and covered with oil, and held over the fire until the oil blazes and burns off. Moving and shaking the pan about causes the temper to be more uniform. In the case of heavy springs the operation may be repeated twice or three times.

A GIRTH-TIGHTENING WHIP CROCK.

BY J. C. KING.

THE buckhorn of a hunting whip is termed a "crook" or "crock," but sometimes iron, nickel, or brass is used; a whistle is often formed in the crock, sometimes a spring loop to take the rein of another horse, or for similar uses. But the best use is to form of the buckhorn a grip for tightening the saddle-girths.



A Girth-Tightening Whip Crock.

It is simply done: a flat is cut on one side of the horn and roughened with cross-cuts as of a file; a hole is bored in the end near the socket that takes the whip handle or "crop," and a small mortise an inch from the end at the edge of the roughened horn is made. A nickel vice-jaw, an inch long and ⅜in. wide, is the movable jaw, which turns only about ⅛ of an inch in the mortise, the turning being on a long screw through the projecting angles of the jaw, and lengthways of the buckhorn crock. The jaw is always a quarter of an inch open till closed with the thumb pressure, which causes it to grip the leather of the saddle called the "point," which takes the girth-buckle.

The illustration shows the whip being used by the huntsman's hand pressing up the saddle-point strap, and drawing it through

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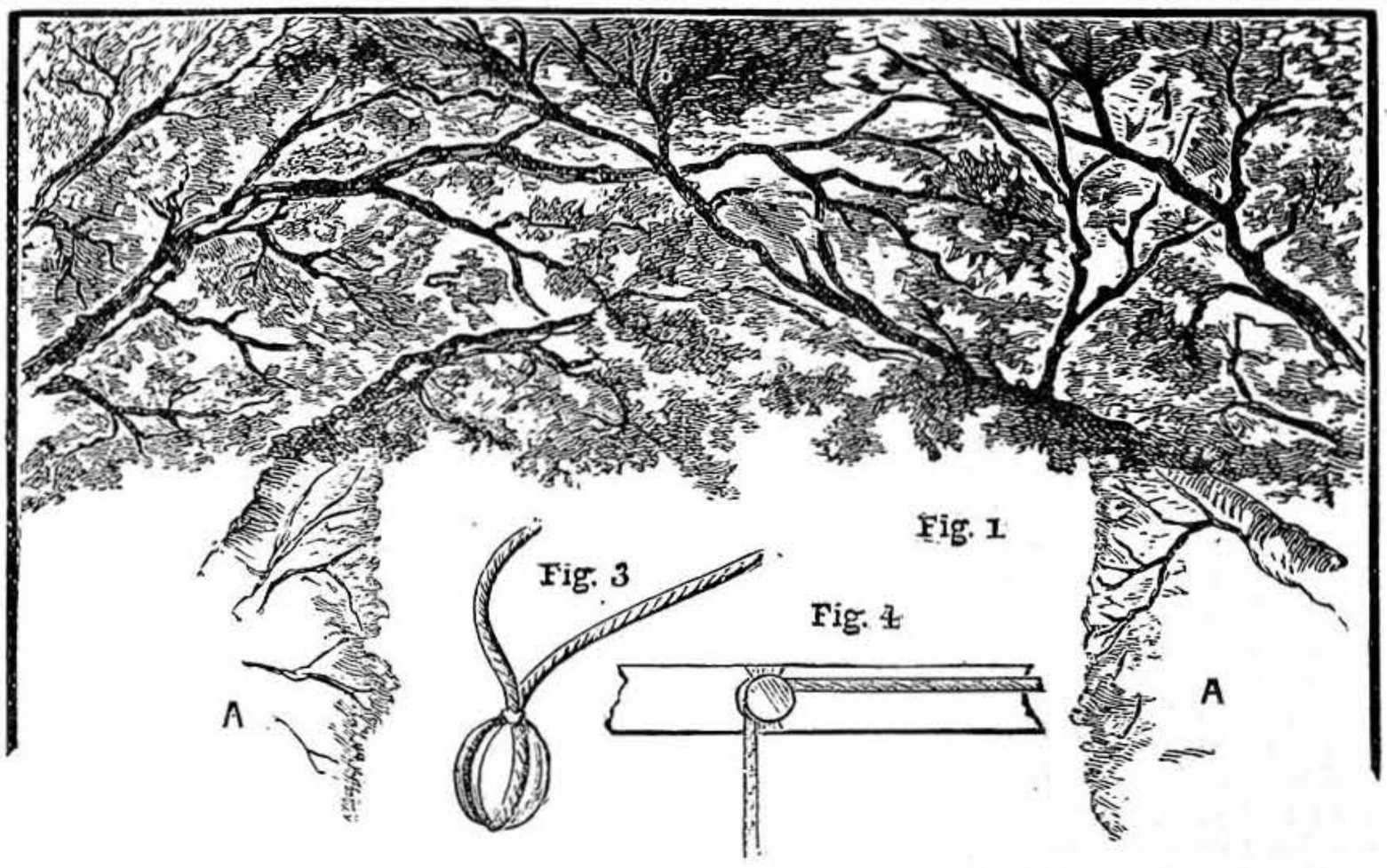


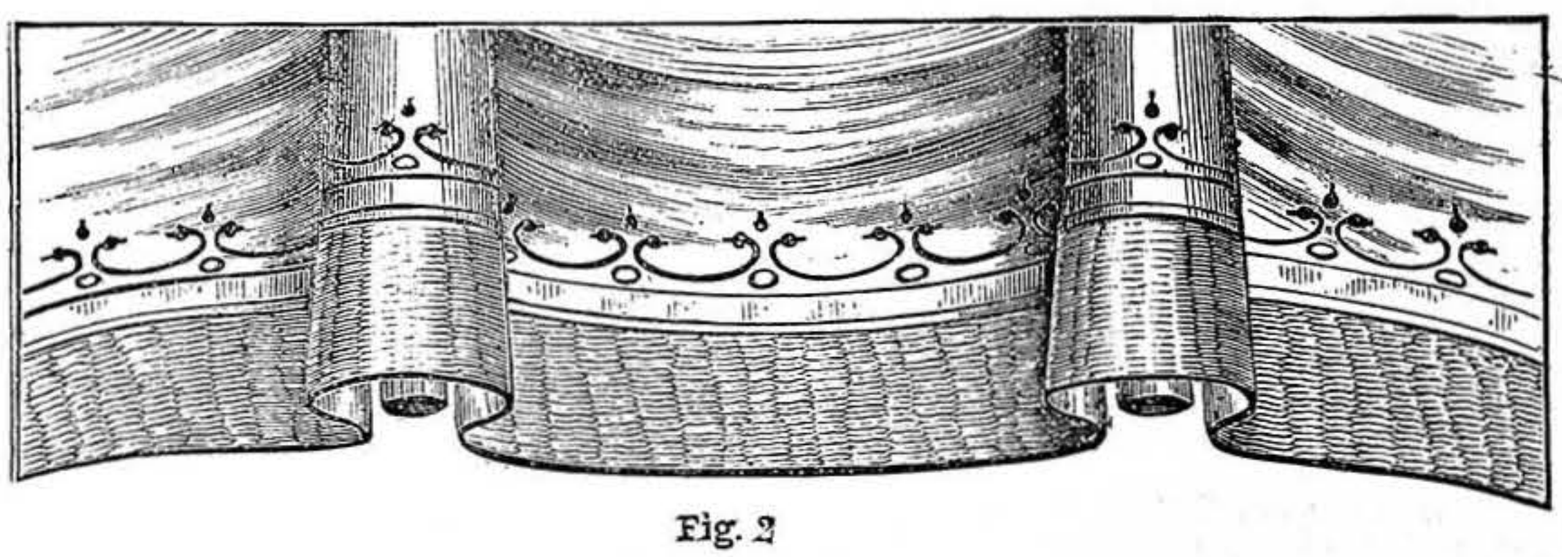


Fig. 2

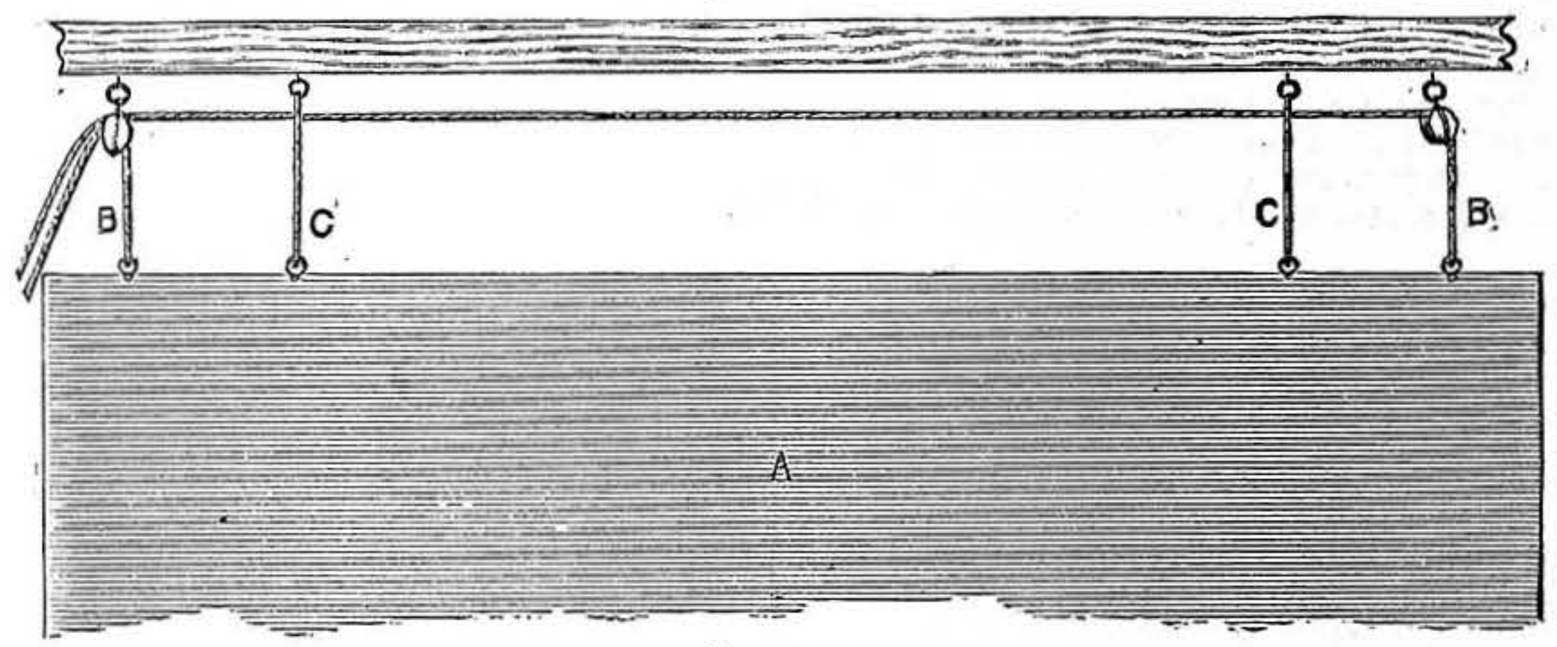


Fig. 5

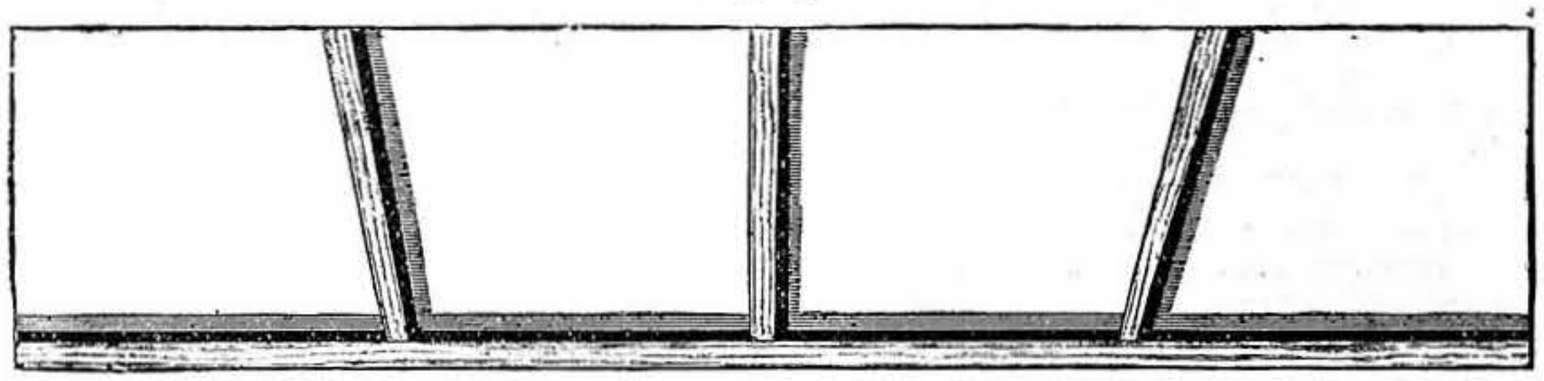
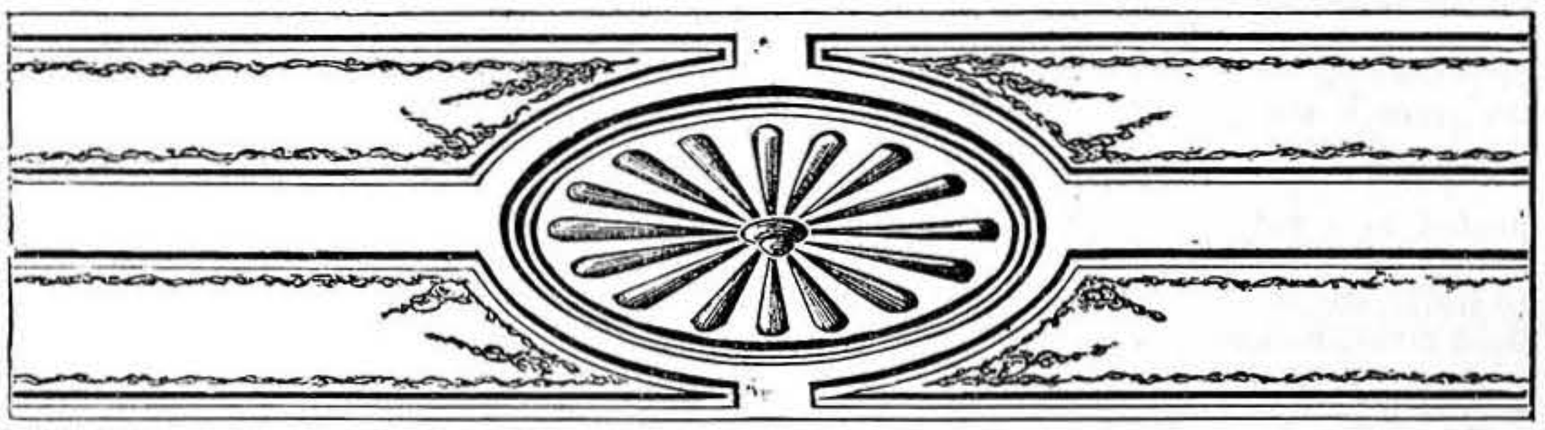


Fig. 6

Fig. 7



BORDERS. Fig. 1.—Cut Border: Foliage. Fig. 2.—Cut Border: Drapery. Fig. 3.—Small Wood Block for raising Border. Fig. 4.—Arrangement for raising Border. Fig. 5.—Border (A) with Pulley Blocks (B) and Dead Lines (C). Figs. 6, 7.—Borders representing Ceilings of different kinds.

the girth-buckle. With this grip the fingers are not strained, as the power of the hand lightly used is sufficient to draw a girth tight. Grooms often catch hold of the girth-point with their teeth, to their injury. The metal jaw is not in the way, and weighs about half or three-quarters of an ounce. The equestrian readers of WORK are welcome to the use of the invention.

STAGE CARPENTRY.

BY WILLIAM CORBOULD.

BORDERS, GROUND ROWS, ETC.

BORDERS are classed under several heads: such as sky borders, tree, interior, and drapery borders. The making of them is the same, as far as battens and canvas go, but the painting is quite another thing; of that, further on.

In making a border, the most particular thing is to have a good batten of sufficient strength to keep the canvas straight and flat, especially sky borders. There should be no creases; the reason is obvious. Suppose we have a border, say, 15, 20, or 30 ft. long, and 3 ft. or more deep, you must stretch your canvas on a frame or some flat surface. After you have done this, make some good priming. What I mean is, let your size be strong, but not too much whiting, as borders, as a rule, get a deal of knocking about; if you had too much whiting they would crack and show bad places. When your priming is dry, it will be ready for painting, if a sky border; or for an interior ceiling or drapery, it would be ready for drawing in your subject. Should there be cutting-out to do, such as hanging branches and leaves of trees, or drapery (see Figs. 1 and 2), you would, after painting, take the border off the frame, lay it flat upon the stage or floor, and tack it to your batten; you may then hang it up, say, shoulder high, when you can cut, foil, or do anything you wish. After it is all complete, you may hoist it into its place, hanging it with two or more "dead lines" to beams, rafters, or any place of safety with "screw eyes" having a firm hold. Should the borders be required to rise and fall, small blocks would have to be used.

With regard to blocks, I would advise the amateur to use small wood blocks (see Fig. 3). They are far better than the iron (Fig. 4), as the wood blocks will work about with the pulling of the ropes; on the other hand, the iron ones, being fixtures, soon cut the ropes. If you have movable borders, always have good dead lines attached, to prevent accidents (see Fig. 5; A, border, B, B, pulley blocks, C, C, dead lines), for should the block lines give way, the dead lines would prevent the border from falling.

When representing interiors, be careful with the perspective; although a border may be hanging down, it may be made to appear flat by attending to your perspective (see Fig. 6, representing an old ceiling with oaken beams, and, may be, plaster between them). Fig. 7 might be that of an old baronial hall. Fig. 2 is a border drapery, such as a proscenium front; this may be of different colours, such as crimson, blue, green, or amber, with gold or silver bullion fringe and ornaments. I shall give a description of their painting and manipulation when I treat of drapery painting.

We now come to ground rows or borders, rises and sinks, etc. A ground row may

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consist of rocks, banks, foliage, water, etc.; they are usually fixed by small dogs (see Fig. 8; A, B, C). Supposing you wished to represent, say, Loch Lomond, with its numerous islands—I have done this with six border rows; the first—that is, the one nearest the footlights—would be painted, the water rather rough, such as a stiff breeze would cause; the next border would be less rough, the third still less than the second, and so on with each one, the last being quite flat and pale in colour, the colour in each growing less in strength; you thus get a broad flat surface in proper perspective. Where you wish to represent an "island" you raise it with profile, as in Fig. 9. Boats may pass between the borders. Some years ago I painted the scenery for the gathering of the "Scottish Clans" at the Theatre Royal, Stockton-on-Tees. The chiefs were represented by children in a boat drawn by two swans; the water being frosted, the moon shining full down on the lake, the beacon fires on the hills, and signal lights of different colours, combined to make a splendid scene.

The *Colleen Bawn* is another play where, in the cave scene, water rows are used with a boat. Sometimes water rows are made with gauze, either pale blue or green; or the water painted—that is, the waves or riplets painted on the gauze, this being held in its place by two iron pins from the wings. A cord through the top of this gauze could be also fastened to the wings.

Rises and Sinks.—These are borders which rise through a slide or trap in the stage (see Fig. 10) managed by counter weights; used principally in transformation scenery. To give a description here would be impossible. This all depends on the fancy of the author or artist, which might be weird, grotesque, or any beautiful subject, such as the "Coral Caves of Neptune" or "A Cavern of Sparkling Gems."

In Fig. 10, C C is slide open; A, ground row rising; D, D, counter weights, manipulated from under the stage; at B, on the dotted line, the cord is fastened to the bottom of the border, the cord passing round the grooved wheel, the weight being gently pulled down by the hand.

SHORT LESSONS IN WOOD-WORKING FOR AMATEURS.

BY B. A. BAXTER.

Boring Holes.

THERE are a great variety of tools used to make holes in wood, and apart from the question of size, which is of importance, there is also a question of suitability. We will look at a few of these tools. Bradawls are well-known and useful tools for soft wood. Having a cylindrical stem, and being ground to a chisel edge, shows the observant amateur that the chisel having cut the fibres, the wedge-like form of the tool pushes them aside; used in end grain it scrapes and pushes its way in, and though roughly, yet effectually makes room for a nail or a screw. I am far from denying that the bradawl can be used for hard wood, but its special use is for soft wood, and its province is limited to comparatively small holes. In hard wood it is to be turned back and forth more freely than is necessary in soft wood, the edge acting more like a scraper in the harder material. The great fault of the bradawl is that no provision is made for the waste material, which is the reason why it is limited to small holes.

Gimlets are equally well known. They may be regarded as useful tools for the tool-basket, having the merit of portability, boring large pieces of hard wood fairly well, and being just as suitable to bore end grain as across the fibres. Let no one, however, trust a gimlet to bore a hole near the end of a narrow strip of wood; the pointed screw, drawing the tool rapidly into the compact wood, is like a wedge, in that it splits the wood quickly.

For small holes in hard wood a small spoon or pin-bit is very suitable, and if the pin-bit is sharpened from the inside as well as the outside, it will cut better. A good all-round bit is that called "diamond twist;" it is in effect a twisted spoon-bit, and good work can be done by it. Centre-bits begin at about $\frac{3}{16}$ in., but, unless very nicely made, the small sizes are not much good; for holes from $\frac{1}{4}$ in. upwards they are applicable, suitable, and cheap; they do not do well for end grain, and should be kept sharp. The bits that are best for all purposes are Jennings' twist-bits; they combine in one article the advantages of gimlet, centre-bit, and the old-fashioned auger, inasmuch as they have a screwed centre-point, two sharp edges to cut the circle, and two chisel-like cutters like a centre-bit to remove the chips; it has also a polished surface to the spiral flutes, along which the waste easily travels.

Gedge's bit, which has two gouge-like cutters, is nearly as good, and in one respect better, for by its aid you can enlarge an existing hole. There is also a new bit which will cut a semi-circle from the edge of a piece of wood; it has an almost continuous circular cutting edge, and two cutters to remove the inside wood. I have not tried it, but it seems to have all the requisites of a good tool.

Clark's expanding bits are excellent for organ-builders and others who require great variety of sizes; they work well, and would cost less than the number of centre-bits, whose work they are capable of doing. There is also a new expanding centre-bit recently introduced, but it does not work to perfection; the movable cutter in the one I have is too much like a scraper rather than a chisel. That is a slight fault which doubtless will soon be remedied by the makers.

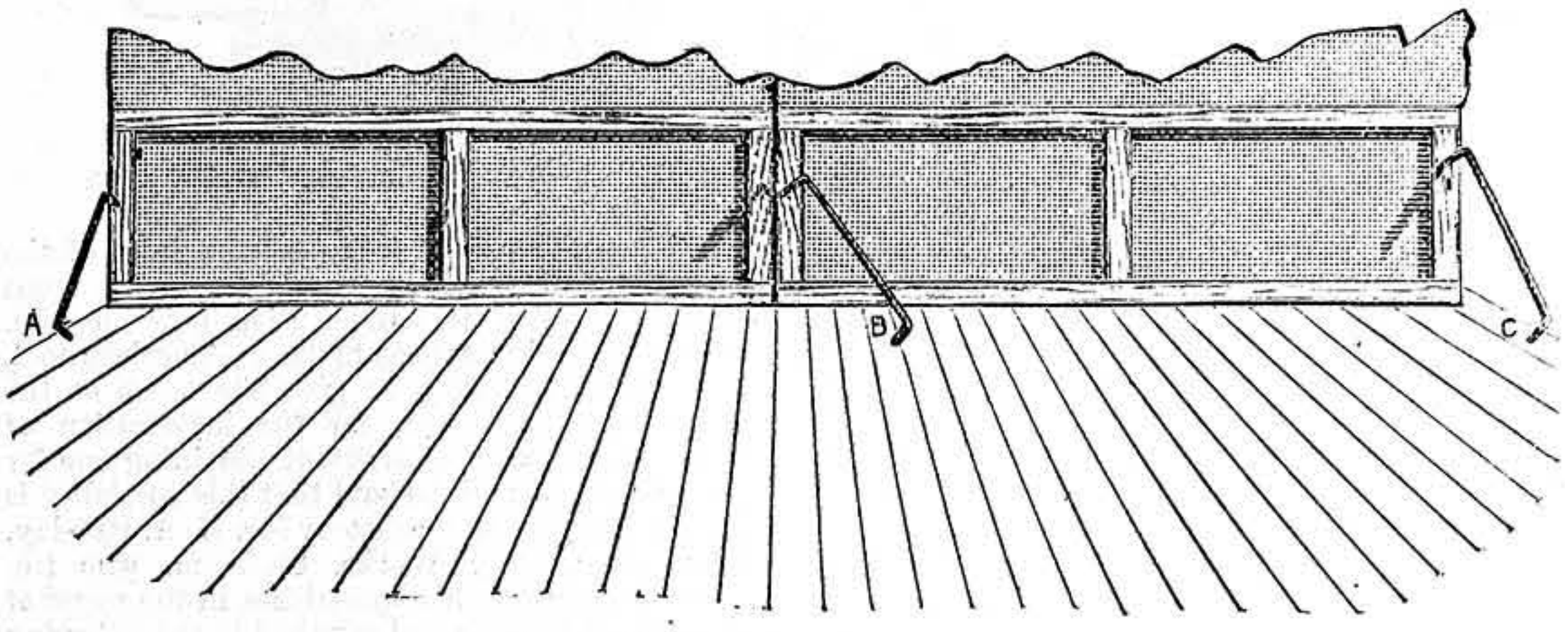

Fig. 8

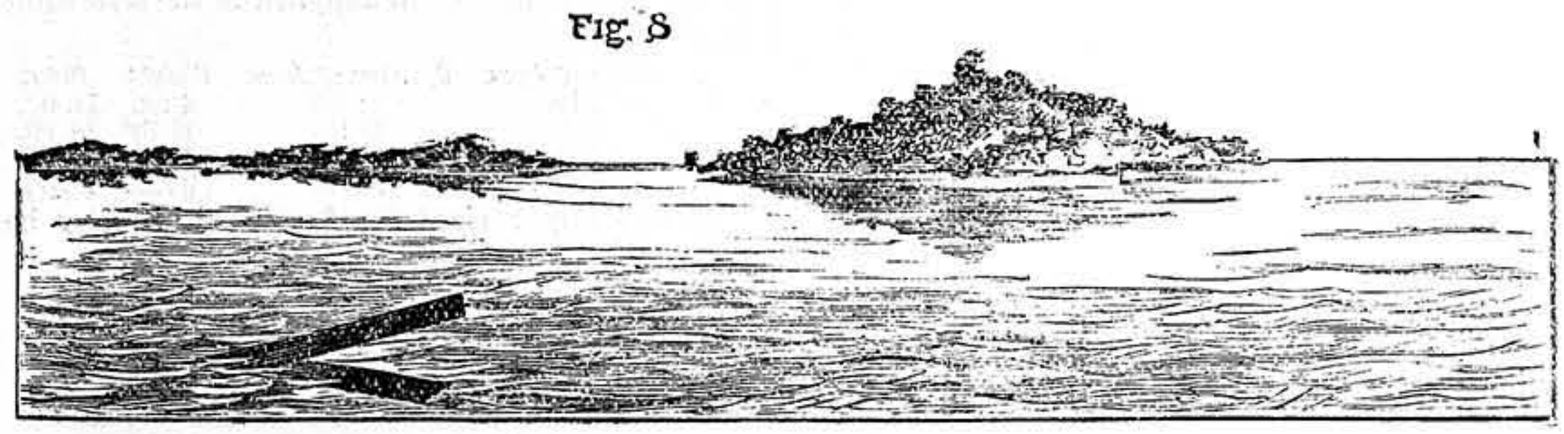

Fig 9.

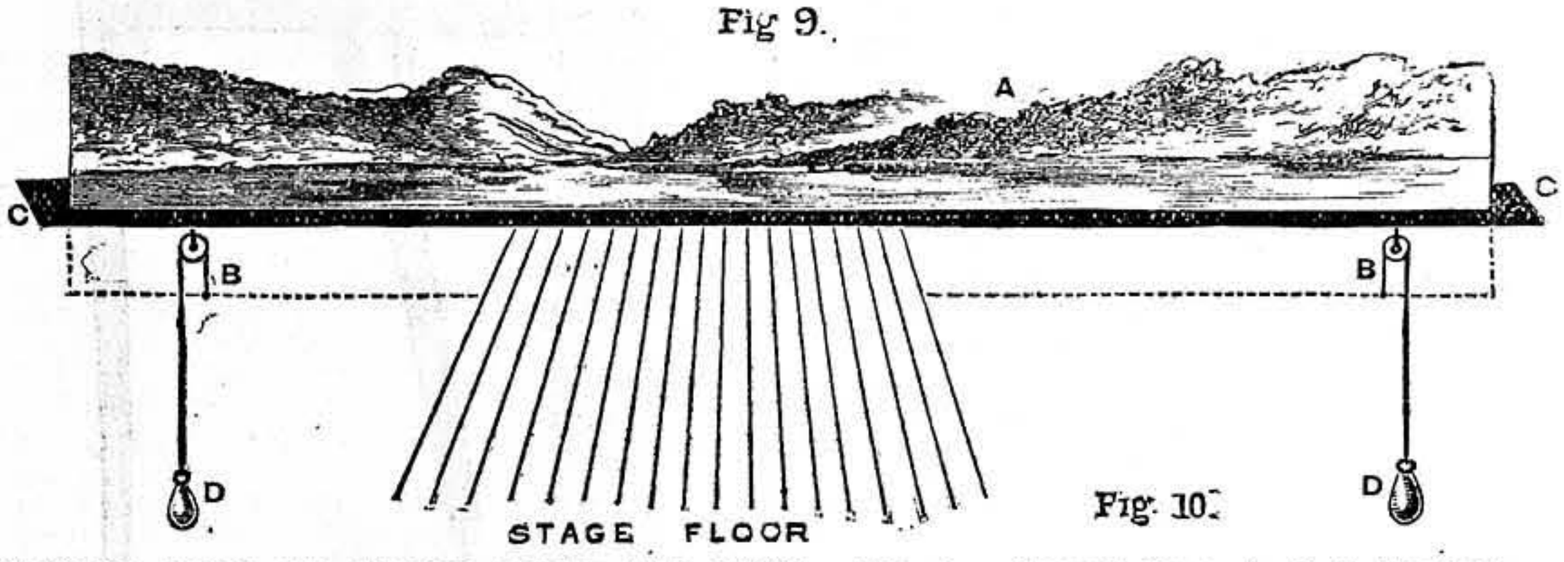

Fig. 10.

GROUND ROWS, OR BORDER RISES, AND SINKS. Fig. 8.—Ground Row—A, B, C, Small Dogs. Fig. 9.—Ground Row. Fig. 10.—Ground Rise and Sink, showing the Scenic Portion comprised therein (A), with Pulleys (B).

Panels and Frames.

I have treated upon planing, sawing, setting out, and, to some extent, mortising and dovetailing; it will, therefore, involve a combination of several operations which we have learnt to make a frame and panel. A panel, in woodwork, is defined as a piece of board whose edges are inserted in a frame; the panel is usually thinner than the frame, but it may flush—that is, even on one side with the surface of the frame. It may be equal in thickness to the frame, then it is flush both sides, or two thin panels may be inserted in one frame, each panel being flush to a surface of the work. Flush panels are often used for doors intended to be covered with baize or cloth. Sometimes the panel is inserted in a groove, in which case, of course, it must be made, finished, and inserted before the frame is glued up. A

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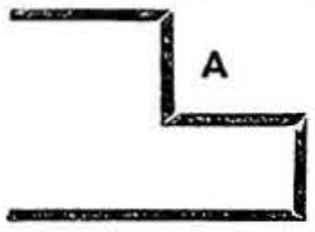
popular novelist once described a joiner, whose thoughts were otherwise employed, as forgetting the panel, and putting the door together without; a clever but an almost incredible illustration of absent-mindedness.

Amateurs must bear in mind that the panels must be inserted, if in a groove and set back from the front, in a perfectly finished condition. For this reason, and because panels are often veneered, carved, French polished, or otherwise ornamented, the frames are often rebated, instead of grooved, for the reception of the panels. In such a case the panels may be fitted after the frame is constructed, and can be removed at pleasure; such a method, which is very common among cabinet makers, is suitable for amateurs. I suppose I need not explain what is meant by a groove; a "rebate," however, is a more technical term. If a piece of the frame is removed, having its edges at right angles to the surfaces of the frame as shown in the annexed diagram at A, it is called a rebate; illustrations of its use can be seen on any picture frame or moulding intended for picture frames. There are many ways of fixing panels in rebated frames, but the method used largely depends on whether the back of the frame and panel are visible; if so, the panel is generally fixed with a bead or moulding nailed or pinned to the frame and not to the panel. The amateur may be well content to fix his panels in this simple way.



Rebate.

Frames and panels should be "square"—that is, unless otherwise intended, they should have the four angles equal, and all right angles. This *cannot* be the case unless the opposite sides are equal; it is for this reason that learners are taught to set out the stiles and rails in *pairs*. If the stiles and rails *are* so prepared, the opposite sides of the four-sided figure are *parallel*, and all we have to do is to see that the diagonals are equal, and we can then be sure that the angles are equal, and are each a right angle. I dwell on this because in large work, such as large window frames, there is no more accurate way of "squaring" the frame than this method of making the diagonals alike, provided always that the sides and ends are equal, or, as the geometricians say, "each to each," and are straight. As I am writing for amateurs, I should like to remind them that the same method of diagonal measurement to determine the angle is applicable alike from land measurement for buildings down to carpet planning or cutting floor-cloth; or, in short, any surface which can be divided into triangles can be plotted and copied, either full-size or to scale, by this plan with ease and accuracy.

OUR GUIDE TO GOOD THINGS.

*** *Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of* WORK *for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of anyone who has a useful article for sale to obtain mention of it in this department of* WORK *without charge, the notices given partake in no way of the nature of advertisements.*

105.—PATENT AMATEUR PARALLEL VICE.

THIS neat and handy American tool or workshop appliance may be regarded, and tersely described, as just the "something useful to, and needed by, everyone" who possesses a workshop or workroom, and turns his attention, and devotes his spare time, to doing odd jobs at home. It is true that it is by no means a new tool, and has been, indeed, on the market for years, but it has been improved from time to time as experience has shown to be useful or necessary, and it may now be looked upon as the strongest, most complete, and most serviceable tool of its kind in the market. Nothing but the best car-wheel iron is used in its manufacture, so that the face and jaws are always chilled, hard, and smooth. The

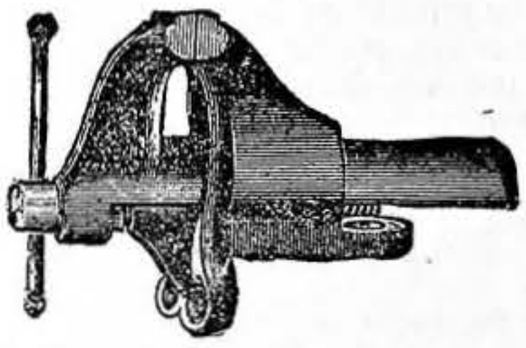


Fig. 1.—Patent Amateur Parallel Vice.

screws are of wrought iron, and the finish of the whole appliance places it at once in the front rank of tools of this description now on sale. Of course, as it happens to be an American tool, there is no necessity to give the name of the American maker, but, for the information of those who may be desirous of obtaining one for his own use, it may be said that this speciality is put on the English market by Mr. H. A. Hobday, Tool and Cutlery Works, Chatham, who frequently advertises his specialities in the pages of WORK. It is made and supplied in the following sizes—

No.	*Width of Jaws.*	*Opening of Jaws.*	*Weight.*	*Price.*
1	1 in.	1½ in.	4 oz.	1s. 0d.
2	1½ in.	1⅞ in.	1¼ lbs.	1s. 9d.
3	2 in.	2½ in.	7 lbs.	3s. 6d.
4	2½ in.	2¾ in.	9 lbs.	7s. 6d.

The two larger sizes are furnished, it may be said, with an anvil attachment.

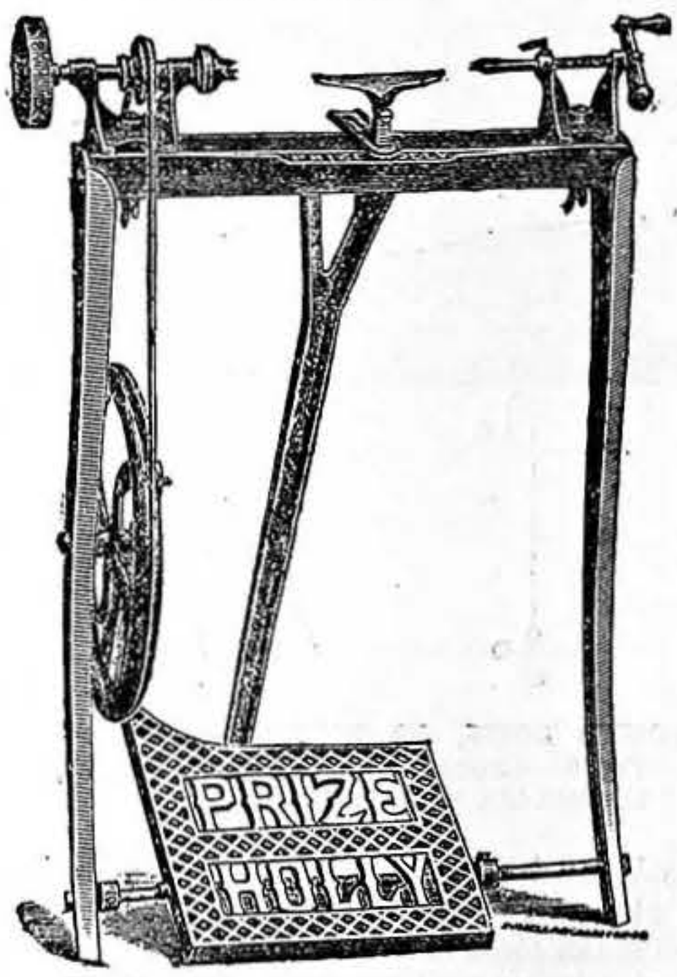


Fig. 2.—Prize Holly Turning Lathe.

106.—PRIZE HOLLY AMATEUR LATHE.

This nice little machine, as will be easily understood by readers of WORK, is specially suited for young beginners, and is in no way intended for those who are capable of using and, indeed, require heavier appliances or machines of this class. It is a lathe of American origin, and may be described as first cousin to the Prize Holly Fret Machine, which is well known here, and is to be found among the stock of every dealer in tools, appliances, and wood for fret sawing. Its price is low, costing no more than 21s., and is sent to any applicant, carriage free, at this price by Mr. H. A. Hobday, of Chatham, who, as I have already said when speaking of the Patent Amateur Parallel Vice, is an advertiser in the pages of WORK. Although cheap, it will answer the purpose just as well, and enable its owner to turn out as fine work and as easily as he can with any other small machine now made—the chief difference between it and them consisting in the plainness of construction and in being somewhat smaller in capacity. Its dimensions and capacity for work are as follows: Height of machine, 30 in.; full width, 18 in.; diameter of balance or fly-wheel, 12 in. A piece of wood, 10 in. long and 4 in. in diameter, may be turned on it, so that a pillar, or pilaster or half-pillar, of this length may be managed. The lathe-bed ways are ground and polished, which affords a smooth and level surface for the head and tail block to travel on. It is also fitted with an emery wheel and drilling attachment, and is sent out at the rate specified above with these attachments and three turning tools. Its strength, durability, and rate of operating is said to be greater in comparison than in any other small machine of its size and character; and it is also claimed that, so far as simplicity of construction goes, its equal cannot be found. As Christmas is behind us, and we are already a month and more on our way towards another, it cannot be said that it will make a good Christmas present for an ingenious lad with a mechanical turn of mind just now, but I may as well remind my readers that there are such days as birthdays, and such times as holidays and home-comings from school, when such a gift will be just as acceptable as at Christmastide.

107.—"A FIRST BOOK OF ELECTRICITY AND MAGNETISM."

Electricity is very fairly—I might say exhaustively—represented in "The Library of Art, Science, Manufactures, and Industries," published by Messrs. Whitaker & Co., seeing that eight of the thirteen volumes that have appeared or are about to be published shortly are devoted to one branch or another of this wide subject. The book now before me, entitled "A First Book of Electricity and Magnetism," has been written for the use of elementary science and art and engineering students, and for general readers by Mr. W. Perren Maycock, M.Inst.E.E., who is Certified Teacher of the Government Department of Science and Art in Magnetism and Electricity, and of the City and Guilds of London Institute in Electric Lighting, and Lecturer on Electricity and Electrical Engineering at the Croydon Polytechnic and at the Whitgift Grammar School, Croydon—offices which, in themselves, are sufficient testimony to Mr. Maycock's thorough capability for dealing with the subject in a lucid and comprehensive manner, so as to render it clear and intelligible even to those who are reputed to be dull and slow to understand. The volume itself, which is abundantly illustrated with engravings of drawings by Mr. Maycock himself and two of his students—Messrs. Checker and Cullingford—is divided into three parts: namely (1) Magnetism; (2) Electro-kinetics, or electricity in motion; and (3) Electro-statics, or electricity at rest. Each part is followed by a series of some fifty questions or more on the subject. At the close of the book a list of apparatus is given, that will be found useful for experiments that should be carried out in illustration, and when treating of each branch of the subject as defined above. Mr. Maycock has been influenced in undertaking the task of providing what he aptly terms "A *First* Book of Electricity and Magnetism" through having found that the various elementary text-books in use, though excellent in themselves, are not elementary in the strict sense of the word, but are somewhat difficult for the beginner—especially the young or ill-educated beginner. The book is written in the simplest possible language, so as to lead nonchalant, dull, and backward students to take more interest in their work than they would if an ordinary text-book were placed in their hands. All teachers under the Science and Art Department will be pleased to know that the book covers the syllabus of the elementary stage.

THE EDITOR.

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SHOP:

A Corner for Those who Want to Talk It.

*** *In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Carpentry.—Markwell writes:—"To such readers of Work as, like myself, have neither workshop nor bench, or even an entirely spare room, it may be of service to know that a very fair amount of pleasure and profit may be enjoyed without them. To make one's dwelling a model of comfort and decoration should be the ambition of every man—and woman too—and where every possible help towards that end is so generously given for the asking to those of a mechanical turn, it does seem a pity that any latent ability should not be cultivated—especially by young people. In my own case the corner of a small room in the back wing is better than nowhere. There is a small fireplace—not much used, for fear of shrinking the wood too much. This is a lesson from experience. Having no place for a bench, I do without it. My makeshift is a fairly strong deal table—45 in. by 27 in.—which cost 7s. 6d. second hand. This was strengthened with well-fitted angular blocks all round glued underneath. In the drawer is a shallow tray—first job—with divisions for loose screws, nails, and sundries. It stands close to a wainscot partition, and 15 in. from chimney angle, between which and the partition is a recess 10 in. deep. Part of an old table leg is clamped underneath the top at the corner and abuts against the chimney, thus preventing the concern from being shaken to pieces. A lot of small work has been done on this; but for larger and more solid work I bought 6 ft. by 9 in. by 2½ in. of dry pine. This lies level with front edge of table and abuts against chimney, is planed perfectly level and true, and has a stop screwed on near the end. It answers admirably for planing on, and on it edges are planed straight and square by laying the plane on its side and using the left hand to hold the work flat on an additional piece, which raises the edge to about the middle of the plane. In this respect it thus becomes a substitute for a bench screw or wood vice. But one can't do very well without a vice, therefore I have a 'handy' iron one. It is correctly named. The jaws open 3½ in., and are 2¾ in. wide. The screw is square-threaded, is ⅝ in. diameter, and works out of sight in a well-fitting square box; the cost of this was 8s. 6d. This is screwed on the end of a piece of 2½ in. stuff, 30 in. long by 9 in. wide, with two fairly strong 1½ in. screws, because it is often dismounted when this block—the face of which is kept perfectly true—is wanted for other purposes. When the vice is used to hold rather thick stuff for sawing, the block lays across the table, and is, besides being stopped in the ordinary way, held fast by weighting it with my two assistants. My brother 'chips' may like to hear about these. Two 14 lb. lead dumb-bells—made for me many years ago—are mounted on two pieces of wood, 12 in. by 3½ in. by 1 in. The ends are partly let in, of course, and a strap of zinc passes tightly over each end, and is tacked to the edge of the wood. The assistance they afford is so great that I would recommend something of the sort to all tyros."

Knotting, Splicing, and Working Cordage.—E. P. B. (*Penge, S.E.*) writes:—"I may say that Mr. Haslope's alternative way of forming 'Tom Fool's' knot by two half hitches is not quite correct, the 'Tom Fool' proper being correctly described by him in the after part of paragraph, and the two knots being slightly dissimilar when finished, as anyone may easily prove. He also passes over the pitcher or jar sling, most generally used afloat. It is made as pattern enclosed, forms a sennit round jar, and is, I think, the most secure of its forms."—[I am obliged to E. P. B. for his criticism. My object being to make these articles a complete manual of knotting and working cordage, I am always glad of any hints or suggestions. I am quite aware that there is a *very* slight difference in the appearance of the knot he refers to when it is made different ways, though for all practical purposes it is identical. I did not therefore consider it necessary to give another illustration merely to show that the strands do not cross one another quite in the same way when the knot is made by the two methods. I do not recollect the pitcher or jar sling he refers to. Perhaps he would kindly give me particulars of it. He speaks of an enclosure in his letter. There was nothing in it when it reached me.—L. L. H.]

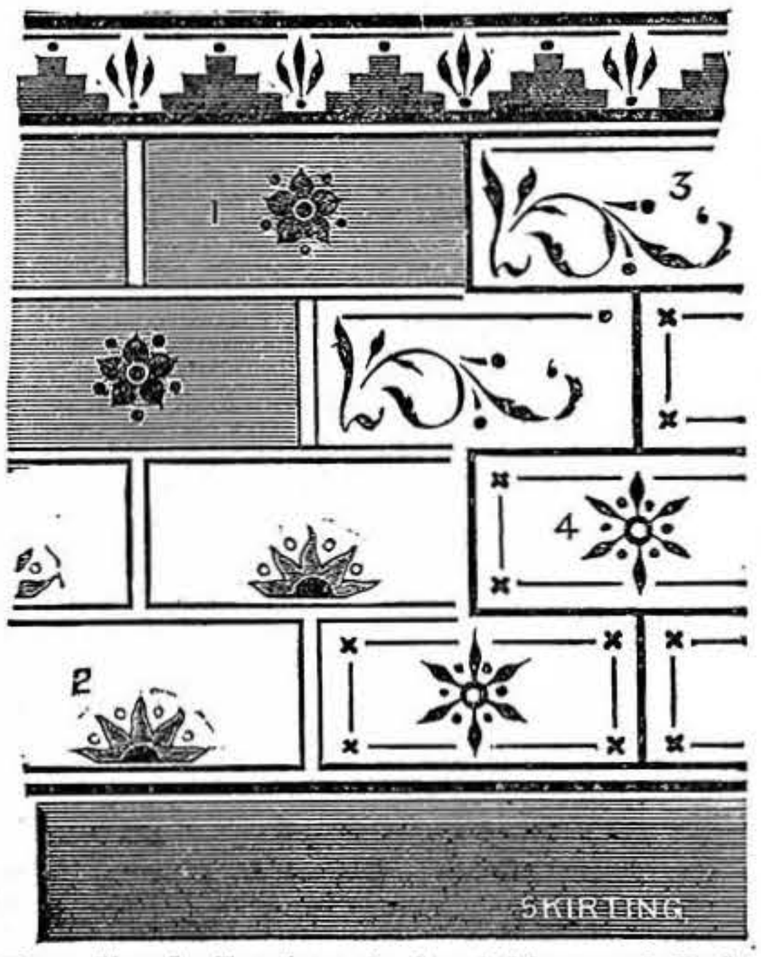
Hot-Air Engines.—Messrs. Norris & Henty write:—"In your issue, No. 141, Vol. III., you publish an article on 'Hot-Air Engines,' by Francis Campin, C.E. There are, however, two slight errors. The first is that Messrs. Potter & Co. are not, and never were, the makers of the Robinson Patent Air Engine. This error, however, probably arose from the fact that Messrs. Potter & Co. have placed several orders for these engines for working their ventilating fans, and no doubt have thus become identified with the engine. The other error is in the list of prices, etc. No. 6 is described as ¼-h.p., whereas it gives from 3-man to ½-h.p."

II.—Questions Answered by Editor and Staff.

Violin Varnish.—Constant Reader.—I am not aware of any of the particular varnish you name being in the market; but if you communicate with Mr. James Whitelaw, St. James's Road, Glasgow, he will supply you with some that will answer your purpose admirably.—B.

Rooms Infested with Bugs.—Woodpecker.—My advice would be to tear down all papers and lime-wash the walls, to thoroughly scrub the floors and all woodwork with carbolic soap, and to repeat the scrubbing after a few days. Into all suspicious cracks and crevices mercury mixed to a paste with white of egg should be put, or the mercury can be dissolved in milk and put into the lurking places with a brush.—M. M.

Papering and Painting.—E. H. S. (*Plymouth*).—Probably you have derived some assistance from papers which have appeared since you wrote. Your painstaking and explicit letter shall, however, be fully answered, and I hope the information will be in time for your purpose. I take it, the porch you allude to is between an outer and an inner door. For this, paint is certainly preferable. Paint it three or four coats, if it is thoroughly dry, according to instructions given in "Painting Billiard-Room Walls." You can make, doubtless, a fair imitation of either grey or pink granites by coating the wall with a ground colour of pink (made with white lead and venetian red), and then, with a piece of honeycomb sponge, marking it when dry with first white and then black paint. Black and white spotted upon a medium grey or lead-colour ground will give an easy imitation of grey granite. A coat of varnish for finishing is advisable. Granite is scarcely what I would use myself; it is rather heavy and a little inelegant. If the work were painted a plain Bath stone colour, the intersecting lines being run in with dark red, you would get a more tasteful effect. If you can draw a little, and cut a simple stencil, better still. You can then carry out the idea the rough sketch above will convey. Use dark red or brown for lines and ornament also. You would only use *one* design, and could easily manage a simple pattern by the aid of a compass. Keep them smaller in proportion, rather, on your wall, than I show. The lines can be made with a straight-edge and lining fitch (see "Painters' Brushes"). I wouldn't advise an attempt to imitate any *marble;* it would, probably, result in a "daub." Walls should be coated with glue size before being papered. Paste is best made with a small knob of alum in the boiling water used for mixing. Certainly, if you can afford it, varnish hall and kitchen papers. You will not get a paper fit for or worth varnishing for much under 1s. per piece. Don't use good varnish on a common paper; if varnishing at all, have a decent article. "Sanitary" papers, from 1s. per piece upwards, are good value, and can be sponged, but not washed. Paper must be twice coated with patent size previous to varnishing. The size must be applied in liquid form; hence the print of the paper must be made for that purpose, so that it will not rub up.—Decorator.



Four Simple Treatments for Ashlar-work Dado, with Border.

Electrical Machine.—W. T. T. (*Houghton-le-Spring*).—The Winter electrical machine described and illustrated in No. 134, Vol. III., cannot be made to produce the electric light. Such machines produce thin currents of extremely high tension. The converse is required for electric lights.—G. E. B.

Electric Lighting.—J. A. (*Gristhorpe*).—In No. 99, Vol. II. of Work, at p. 758, under the heading of "Working Dynamo-Electric Machines," you will find my remarks on the use of windmills for electric lighting purposes. My advice to you is, give up the idea altogether. It is not altogether impossible, but is most impracticable for an amateur.—G. E. B.

Iron Bridge Building.—J. S. W. (*West Bromwich*).—For particulars as to this, see article on "Wrought Iron and Steel Girder Work," in No. 24 of Work, p. 375.

Photographic Schools.—J. D. (*Bethnal Green*).—The only schools with which we are acquainted in which photography is successfully taught are the Guildhall Technical Institute, in the City, and the Polytechnic, in Regent Street, in which classes are held and instruction given by thoroughly competent men. In reply to your other question, the data given are insufficient to permit any definite conclusion being drawn. There are two reasons, one of which is probably the right: First, that you omitted to draw up the shutter of the dark slide; and secondly, the time of development was much too short. Very few plates will develop properly in less than two or three *minutes;* certainly *none* in the time you mention. Interiors of all kinds, well lighted or otherwise, require a longer time to develop than exterior views; from five to ten minutes is not considered long for such subjects, and may sometimes, in certain cases, require an hour or more. You had better procure a shilling elementary hand-book on photography, from which you may derive much useful information.—D.

Photographic Varnish and Enamelling.—W. S. (*Harrow Road*).—The varnish you require is made by dissolving 1 oz. of Canada balsam in 4 oz. of pure turpentine; or, take 1 oz. of mastic gum in half a pint of spirit of turpentine or wine, and a couple of drachms of nut oil. I give the preference to the Canada balsam varnish. Before the application of either, the picture must be properly sized by coating it evenly on both sides with a warm solution of gelatine, ten grains to the ounce of water, in which one grain of chrome alum has been dissolved, and permitted to get thoroughly dry. With small pictures, immersion for a few minutes in the gelatine is best, but with large surfaces this is impracticable. If the paper is not properly sized, the absorption of the varnish will cause dark marks, and give a patchy, unsightly effect. If the picture is to be mounted, it should be done before sizing. In reply to question No. 2, provide the following: Supposing there are half a gross of cabinets to be enamelled—two dishes (one considerably larger than the other), a squeegee, a pound jam pot, white wax, 1 oz. Nelson gelatine, a bottle of enamel collodion, and a sufficiency of pieces of glass free from scratches, rather larger than the prints to be enamelled. Set to work by putting the gelatine into the jar, and filling up to within half an inch of the top with clean cold water; leave this to soak for an hour or so. In the meantime polish the glasses on one side, and scribble over them with the white wax: the word "waxed," written large, on them will do. Hold them before the fire to get well warm and the wax melted; then rub them all over with a pad of calico free from size or fluff, and as they get done set them up edgeways one behind the other. Now place the jar containing the gelatine and water in a saucepan of water on the fire till the gelatine is melted and well heated. Into the larger dish pour some boiling water; set the other dish in it, and into this pour the dissolved gelatine. One by one place the prints in this gelatine solution, and leave them there. Now take a waxed plate, and on the waxed side coat it with enamel collodion, rocking the plate to get an even layer. As soon as the collodion has well set, and feels firm to the touch, wash under a tap or in a dish till the greasiness disappears. Now approach the glass near to the prints in the gelatine, and lift one out, laying on the glass face down (collodion side), and with the squeegee passed two or three times over it, to remove the superfluous gelatine and air bubbles; sponge off the face of the glass, and set in a warm dry place to dry. When *quite* dry, the prints will often peel off of themselves; if not, a penknife passed under one corner will permit them to be easily stripped off. Note.—All spotting must be done before enamelling, and the colour mixed with albumen, and afterwards dipped in methylated spirit to render it insoluble; also trim the prints beforehand, and they must be mounted before they are removed from the glass support, or they lose gloss. Care must be taken to avoid bubbles between the glass and the picture; they will be observed as silvery-looking spangles, and must be pressed out with the squeegee; but if the prints are carefully laid down in the first place, there will be very little trouble. If the prints stick to the glass or tear, the waxing is not sufficient, or not all over the glass; let the prints get *thoroughly dry* before attempting to remove them, or they will be certainly spoilt. Be careful not to froth up the gelatine solution in pouring from one vessel to another, or by moving the prints about in it unnecessarily. Let everything but the collodion be kept warm during the continuance of the process. When large quantities are enamelled, a number are squeezed on to a large sheet of glass.—D.

Magic Lantern.—M. A. P. (*South Shields*).—An article on "How to Make a Magic Lantern," written by a practical hand, is with the printers, and will appear early in the new volume of Work.

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Damp-Proof Developing Shed.—P. B. (*Clapham*).—Yes, it is quite practicable. An excellent small dark room, called the "Eveready," made by Davenport & Co., Parkhouse Street, Camberwell, for two guineas, would supply your requirements; the size is 6 ft. 6 in. by 3 ft. 6 in. by 3 ft. This is not covered with any waterproof material, but might be made thoroughly watertight by covering it with "Willesden" canvas or paper, and raising it from the ground by a few bricks or battens of wood. An article appeared in WORK a few months ago on "Dark Rooms" which might probably afford you some information.—D.

Glaze and Red Stains.—G. G. (*Clapham*).—Glaze is made by dissolving 6 oz. or 8 oz. of good gum benzoin in 1 pint of methylated spirits; carefully strain before using. The benzoin, to be good, should cost not less than 2s. 6d. per lb., and glaze once made improves by keeping. Patent glaze, as sold by most druggists and shellac merchants at about 8s. per gallon, is considered by some polishers to be very good; but for good work, though costing nearly double the price, the home-made article is much to be preferred. If, as you say, you have taken in WORK from the commencement, you must surely have missed the article on "Glazing," by David Denning, p. 338, No. 126, which you will do well to carefully read. Red stains, as made from madder-fustic, brazil chips, logwood, dragon's blood, or red sanders, are now looked upon by most practical French polishers of to-day as old-time methods, and for small jobs is rarely used by them, Bismarck brown having superseded them by reason of its being readily dissolved in water, glue, size, or spirits. It is usually sold at the same place as shellac, etc., at about 6d. per oz., and though this sounds dear, I can assure you that it is not so, owing to its powerful nature. If you have a large job on hand, and prefer the stains as made by chips, etc., I append a few recipes: A light brown mahogany colour may be given by means of a decoction of madder and fustic wood ground in water, ½ lb. madder, ¼ lb. fustic, 1 gallon of water; for a darker mahogany, omit the fustic; add instead 2 oz. logwood chips, which, when dry, should be wiped over with pearlash, 1 oz. dissolved in 1 quart of water; for a bright red, make a strong infusion of brazil chips in water, to which has been added pearlash, 1 oz. to 1 gallon: while the work is still wet with this stain, brush it over with alum water, 2 oz. of alum to 1 quart of water; or, for the same colour, dissolve 1 oz. of dragon's blood in 1 pint of spirits.—LIFEBOAT.

Newspaper Illustrations.—T. M. (*Shields*).—The artistic and mechanical stages are generally quite distinct. The drawing is prepared by the artist in black ink upon a smooth card; it is then handed to the photo-etcher, who produces a relief block from it by a photographic and etching process. This is a distinct business in itself, and cannot be practised by a novice. There is one way of combining the drawing and engraving processes—namely, by drawing direct upon a metal plate with a prepared surface by means of a graver. The picture is at once ready for the stereotyper. Apply to the Hoke Engraving Plate Company, 37, Walbrook, London, for particulars.—W.

Polishing Tinware.—MAKER BY THE GROSS.—To properly polish tin goods, they should first of all be thoroughly cleaned from spirits of salts, then well rubbed with oil and whiting, then again well rubbed with a dry cloth, and finally polished with a soft duster and dry whiting. I have never found any difficulty in getting a good polish by these means. Of course, in large shops they use a polishing wheel with buffs of various shapes and sizes to buff up the goods, and if you want the same high degree of finish, you must do the same. I am unable to tell you how the bends of hurricane lanterns are made, but most probably with a die-press.—R. A.

Plumbing.—NED.—The following are good works on plumbing: "The Plumber and Sanitary Houses," by S. Hellyer, price 8s. 6d., published by B. T. Batsford, 52, High Holborn; "Plumbing," by W. P. Buchan, price 4s., Crosby Lockwood and Son, Stationers' Hall Court, Ludgate Hill; "House Drainage and Sanitary Plumbing," by W. P. Gerhard, price 2s., Spon, 125, Strand, London.—M.

Robinson Hot-Air Engine.—E. W. S. (*Egham*).—We cannot give insertion in the body of WORK to the name and address of the makers of this engine.

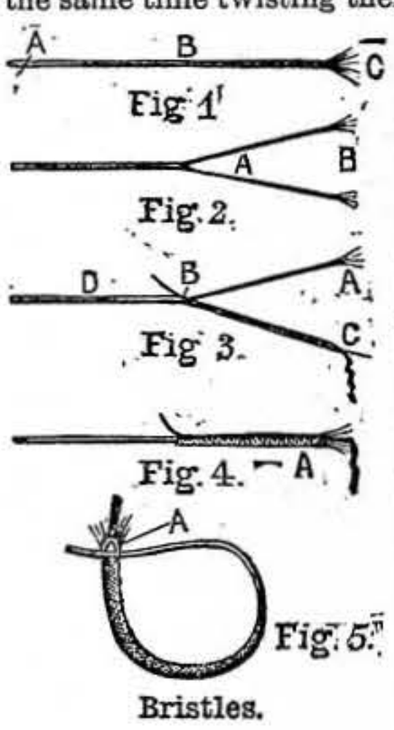
Scene Painting.—A. W. B. (*Glasgow*).—The articles on "Scene Painting" appeared in Nos. 92, 95, 97, 101, and 103 of WORK.

Wardrobe Mirror.—READER.—Surely in your town, or near it, must be a furniture warehouse; if so, apply to them, stating size and whether bevelled. The carriage from a London firm would, on a single plate, far exceed the price charged extra for the same reason by the provincial firm, who would probably have received their glass in great quantities. The addresses of some London firms have already appeared in "Shop," which you might easily ferret out. Inquire again if still unsatisfied, but meanwhile try the indexes to Vols. I. and II. of WORK.—J. S.

Tinman's Tools.—R. L. T. (*Plumstead*).—You will find the illustrations of tinmen's tools and machines in Nos. 67 (p. 209) and 78 (p. 413) of WORK, and you can obtain them by ordering through your newsagent or direct from the publishers.—R. A.

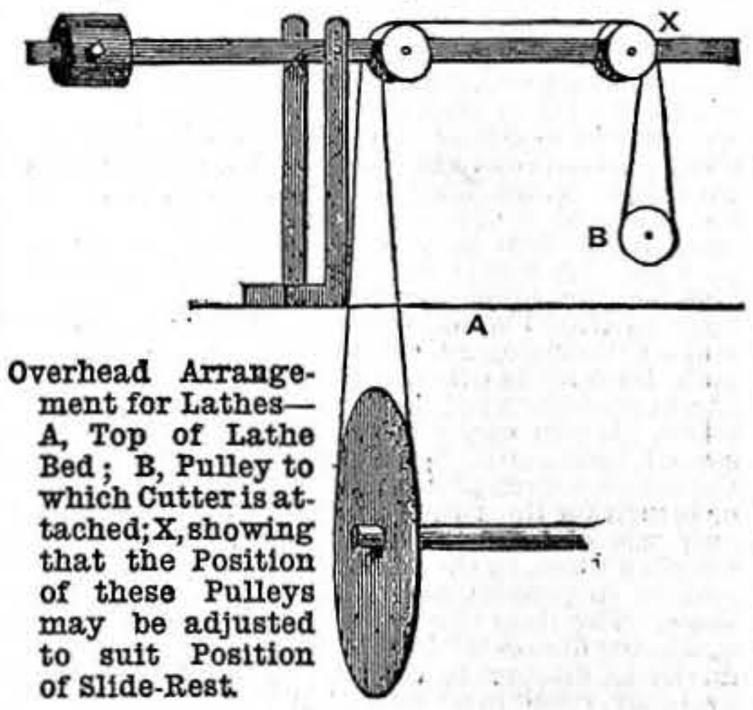
Lead-Burning Machine.—A BURNER.—The proportions of zinc and acid vary somewhat in different machines, but you can try the following: 7 lb. of zinc clippings in the lower reservoir, 3 quarts of water and a pint and a half of sulphuric acid in the upper reservoir, and add about a pint of acid for each two hours of working. The zinc will last about a week. The saturated acid should be drawn off after each usage.—R. A.

Fastening on Bristles.—A. H. (*Nottingham*).—First pick a pair of good bristles, that is, of equal substance, and as transparent as possible; from A to B (Fig. 1), on the end of each bristle, there is a dry, glutinous substance; this is the part that is in the hide when on the animal, and is of no use to us for our purpose; it is, therefore, cut off in a slanted direction, as shown by the line across it at A. Hold the two points together, and stroke them up and down, on a piece of sand-paper, somewhat in the same way as you would use a whitewash brush, holding them between the thumb and finger, and at the same time twisting them round—this will make a nice round point to them; then, about halfway, just bend them against the thumb nail, so as to centre them both in the same place. You now have one end sharp and the other end, C (Fig. 1), bushy, of which you take equal portions between the thumb and finger of each hand, and split it down to B, as shown by A B (Fig. 2). The end of the thread is waxed, and the fine tapered extremity is placed in the crutch, as B (Fig. 3), both of which are held firmly between the thumb and finger of the left hand, the palm of the hand being towards you; then between the thumb and finger of the right hand the split part of the bristle, C, and the thread with it, is twisted towards you; and each time you want to take another sweep, hold the part C, *pro tem.*, between the little and third fingers, and when twisted just tight, twist A in the same direction, being careful not to break it. Then put A and C together, hold them between the thumb and finger of the right hand, and leave go with the left at B, and with it take hold of D, and twist that in the same way. This should give a result as shown in Fig. 4. Then at A, with a fine stabbing awl, a hole, or eye, is made in the thread, and the point of the bristle put through it, as shown at A (Fig. 5). This ia drawn right through, and then smoothed from the point downwards, between the thumb and finger. This, it will be seen, is to secure the ends of the bristles, and prevent them from unplaiting. This method is called plaiting. There are other ways, but this is by far the best, for stitching.—W. G.



Bristles.

Overhead Motion.—LATHE AMATEUR.—If you want a good and efficient overhead arrangement for your lathe, the following diagram may furnish you with an idea of how to go about it, and I would advise you to read it in conjunction with what was said to J. E. J. (*Portsmouth*) upon this same subject in WORK, No. 12, p. 190. A is the top of lathe bed; B, pulley to which cutter is attached; X shows that the position of these pulleys may be adjusted to suit position of slide-rest.—ED.



Overhead Arrangement for Lathes—A, Top of Lathe Bed; B, Pulley to which Cutter is attached; X, showing that the Position of these Pulleys may be adjusted to suit Position of Slide-Rest.

Foot-Blower.—R. H. E. (*Blackburn*).—The bellows with a reservoir is preferable to a fan-blower when worked by foot, because temporary suspension of the action of the foot does not stop the blast, and a bellows treadle is easier to work than a crank treadle. You will require special leather and wood to make the blower, and will find it a troublesome job—at least, that has been my experience in making a similar arrangement for experiments on sound. It would probably be cheaper to buy one. Messrs. Alldays and Onions, of Birmingham, supply all kinds of blowers and bellows. You might have a fan-blower fitted with a reservoir, but there is this disadvantage: a fan is not a positive blower; when the reservoir pressure exceeds that in the fan, you are wasting power in grinding wind.—F. C.

Emery Wheels.—NO NAME (*St. Leonards*).—Emery wheels are made of emery of various degrees of fineness consolidated under pressure with a suitable cementing material. For the actual composition I must refer you to the makers, though I am not sure they would make public their methods. In use emery wheels are run at a surface speed of from 4,000 to 4,500 feet per minute. When used for sharpening small tools, they should be used with water.—F. C.

Steel Tubing.—A. N. H. (*No Address*).—I do not know of any works where solid drawn steel tubing of the size you require is made. The thickness to stand a working pressure of 60 lbs. is theoretically $\frac{1}{10}$ in., but of course you cannot practically use the metal so thin. Your best plan would be to make the boiler of sheet copper about $\frac{1}{16}$ in. thick, riveted and well brazed together; then, as your firebox is of copper, the expansion and contraction under variations of temperature would be equal, and there would be less liability to leak. You might get an electro-deposited copper tube of the diameter you require.—F. C.

Four-Jawed Chuck.—G. H. A. (*Clapham*).—I do not know of any substitute for the four-jawed chuck, but if you call at Messrs. Grimshaw and Baxter's Stores, Goswell Road, E.C., you will most likely find something to suit you. If you are likely to be disheartened in so small a matter as making a model engine, I should advise you not to commence it. You can buy one for a trifle.—F. C.

Beam Engine.—AXLE.—The bars B and C in your sketch form a parallel motion for the head of the piston-rod, or would if they are of equal lengths, assuming that the end of bar B nearest the piston-rod is gudgeoned to the framing. Usually the rod A has a connection for air-pump or feed-pump rods, but you do not show any such attachment. This form of parallel motion is not absolutely true, but when the rods are properly proportioned, restricts the head of the piston-rod to a motion very closely approximating a straight line. I suppose the bars are brass-bushed, and the wear of the bushes causes the rocking of the piston-rod. The dead-centres upon which the rods vibrate may also have worn out of centre. If the engine worked satisfactorily when first started, your remedy is simple: put in new dead-centres in the framing, new bushes in the bars, A, B, C, and new bearings in the piston-rod head and the strap connecting it with the beam. If the rocking of the piston-rod has long continued, the gland is most likely worn oval, in which case a new one should be fitted and the stuffing-box, if necessary, bushed. In regard to the piston-rings, you do not say of what class they are, but for the size you give I should recommend a split cast-iron ring, $\frac{5}{8}$ in. thick on the thick side and $\frac{3}{8}$ in. on the thin side, turned to an outside diameter of $8\frac{3}{4}$ in., cut on the thin side and put in in the usual way. It might be better to put in a new piston with Ramsbottom wrought-iron rings, but whatever rings you use, round off the outer edges so that the cylinder may not be scored by them. If you had given fuller particulars as to the use of the engine, I could have given further advice.—F. C.

Hydraulic Cylinder for Lift.—R. S. (*Manchester*).—Some dimension must first be given or assumed. Your lift is 40 feet; if, therefore, you make your ram with a 5 ft. stroke—that is, one-eighth of the height to which 3 cwt. is to be raised—the load on the ram will be $3 \times 8 = 24$ cwt. The speed of the cage to lift it 40 ft. while the ram only travels 5 ft. is obtained by chains passing over top and bottom pulleys in the usual way so that there are eight lines of chain side by side. One set of pulleys may be fixed to the bottom of the cylinder, and the other set to the head of the ram; from these the chain is led away over the head pulley of the hoist and attached to the cage. In addition to the 24 cwt., an allowance must be made for friction, say, 5 per cent.; 24 cwt. equals 2,688 lbs.; 5 per cent. on this is 135 lbs.; total load on ram, 2,823 lbs. Now the pressure of water per square inch multiplied by the area of the ram in square inches must equal this total. If there is a high pressure service of, say, 100 lbs. per square inch, the area of ram required will be $\frac{2,823}{100} = 28{\cdot}23$ square inches, which we find, from a Table of Areas of Circles, corresponds to a diameter of 6 in. The cylinder would be made about $6\frac{1}{4}$ in. inside diameter. The supply pipe should be about $1\frac{1}{4}$ in. in diameter. Whatever conditions you have you can get at your results by the above method. If, for example, the diameter of ram is fixed at 5 in., this corresponds to 19·63 square inches area, and the pressure required per square inch will be $\frac{2,823}{19{\cdot}63} = 144$ lbs. per square inch. If the pressure is to be taken from a tank, the height of the tank in feet above the ram must be equal to the pressure per square inch in pounds multiplied by 2·31. You will see that we have found the following rule for the total load on the ram: Multiply the actual load by the height of lift, divide the product by the stroke of the ram, and add 5 per cent. to the quotient.—F. C.

Quarter Horse-Power Steam Engine.—A.P.S. (*Hyde*).—It is not possible to comply with your suggestion.

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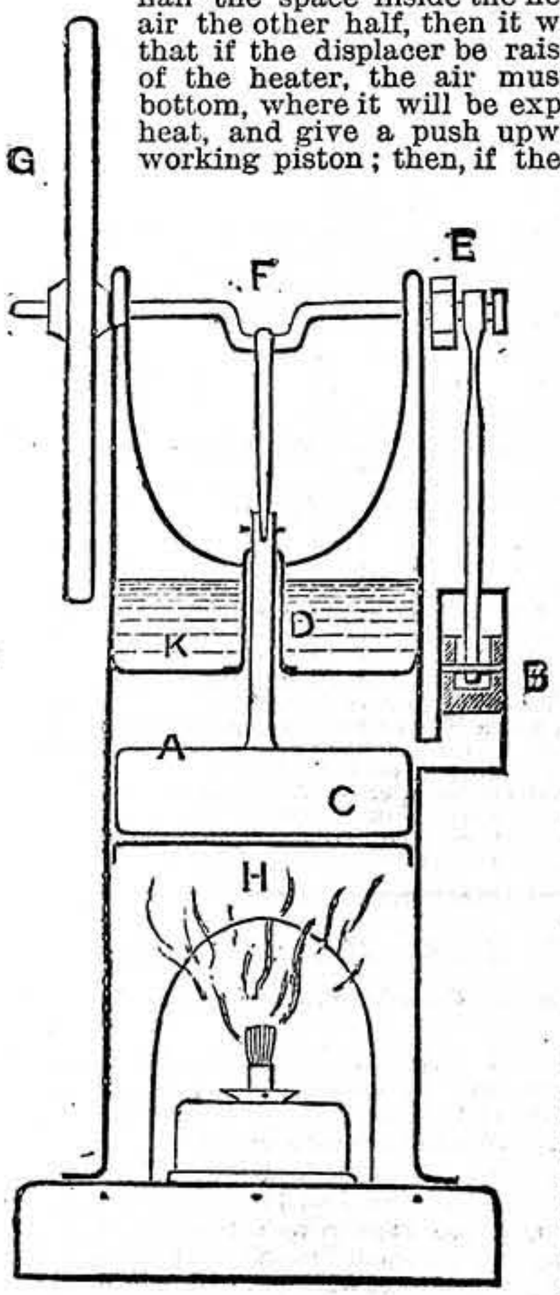
Hot-Air Engines.—W. H. B. (*Leicester*).—In these small hot air-engines there is a cylindrical box, called the heater, containing air, a fixed quantity of which remains in the box, for there is no exhaust; and this air, being alternately heated and cooled, expands and contracts, the pressure varying about 12 lbs. A working cylinder is connected with the heater; in this a piston moves, being forced up when the air is heated, and drawn down when it is cooled; the top of the piston is open to the air, and a connecting-rod fastened to a pin in the piston works the crank at the upper end. Now, we cannot very well remove the fire from the heater at every stroke of the engine, so the plan adopted is to have the fire play upon the bottom of the heater, whilst the upper part is cooled by a water jacket; inside the heater there is a loose-fitting deep piston, called a displacer, whose office it is to move the air up and down, so that it may be heated by the bottom plate of the heater, and then cooled by the water jacket at the top. If we suppose the displacer to occupy half the space inside the heater, and the air the other half, then it will be evident that if the displacer be raised to the top of the heater, the air must go to the bottom, where it will be expanded by the heat, and give a push upwards to the working piston; then, if the displacer be moved down to the bottom of the heater, the air must go to the top, where it will be cooled by the surrounding water, contract in volume, and suck down the working piston. The diagram is a sectional sketch of Seal's model hot-air engine, which, being very simple, will serve to explain the principle on which these engines work. A is the heater, communicating with the working cylinder, B, by a passage always open. C is the displacer, occupying about half of the heater; it is moved up and down by a crank and connecting-rod attached to a piston, which passes through a tube, D, which acts as a guide. E is the crank moved by the working piston; F is another, which moves the displacer, and is set at right angles (about) with the first. G is the fly-wheel. The flame of the lamp plays upon the bottom plate, H, of the heater, and some water is poured upon the top plate, K. The model will start at once on lighting the lamp, and runs at 250 revolutions per minute; it has no power, the working cylinder being so small—only ¾ in. diameter. The model costs 10s. 6d. I have one, and it runs well; perhaps if Mr. Seal sees this he will advertise his present address. The action of these engines will now be easily understood. The heater crank precedes the working crank just as the eccentric precedes the crank of a steam engine: the engine being in the position shown in sketch, the air is being cooled, and the piston of B is being sucked down. In one quarter of a revolution it will have reached the bottom, and displacer, C, will be in the middle of the heater; a little further, and there will be more air beneath the displacer, pressure will increase, and the working piston will be forced upwards, etc. It is curious to find that the air can be heated and cooled 300 times in one minute. The proportion between the space swept by the piston and displacer is important, and I obtained a greater speed by reducing the stroke of the working piston; the working crank might be made with several holes for the crank-pin, and the engine tried with different strokes till the best position has been found. It will now be seen that in Robinson's engine, instead of two cranks placed at right angles, the piston and displacer are themselves fixed at right angles and worked off the same crank, which produces exactly the same effect. The power of hot-air engines is generally rated too high. I tested one with a 9½ in. cylinder, and found that, though the indicator showed 23,716 foot lbs., say, 5-men power, the brake power was only 10,028 foot lbs., say, 2-men power. For 2-men power I should require a 9 in. cylinder, and the engine would be very bulky and heavy.—F. A. M.



Hot-Air Engine.

Damp in Piano.—INQUIRER.—The damp which creates the rust in the bottom part of piano rises from the floor, sometimes through damping the carpet before it is swept. I should advise you to turn the piano up, so that you may tack a piece of oilcloth or waterproof over the bottom, as sometimes there are holes where damp may enter. To clean the rust off, use a piece of leather with a few drops of paraffin oil on, and sprinkle with fine emery powder. Having done this, procure some lard free from salt, and crush some camphor, and mix them together. Rub this over the strings; this will prevent rust.—T. E.

Japanning.—W. P. W. (*No Address*).—You appear to have been very painstaking in your work, and certainly deserve to succeed. I regret that I cannot add anything to the information already given, unless it is to express an opinion that it is scarcely necessary to go to so much trouble over repairing jobs. I should suggest that you simply give the beams, etc., a coat of finest air-drying black japan, and lay on with a camel-hair brush where required some of Pavitt's Gold Ardenbrite, and when dry a coat of clear varnish if wished, but it is hardly necessary, as Ardenbrite will keep up colour for a long time.—R. A.

Patents.—S. G. T. (*Penarth*).—The writer states that, on searching the lists of applications for patents (see "Shop," p. 587, No. 141), he "found that there were about two a day for the last three months for the same kind of thing." He then asks: "Can any of your correspondents tell how we are to know that some of these applicants may not have the very same thing as ourselves, and, being before us, of course have the preference?" We can assure S. G. T. that neither he, I, nor anyone else can ascertain this until the complete specification is filed and accepted, when it may be inspected on payment of the usual fee; or he must wait until the specification is printed, every application for the grant of a patent being inaccessible to the public until the complete specification is filed and accepted. Every person making application for the grant of a patent has to take his chance as to whether a prior applicant has covered his invention. There is no way of getting over this.—C. E.

Plain Sketches.—T. P. (*Frodsham Bridge*).—We do not know of any work specially devoted to this subject, but there are several works which touch on it. Some years ago the Council of Education published, or authorised the publication of, books on drawing, one of which gave instructions how to sketch from the object, but we do not remember the name of the author. Spon, publisher, Strand, W.C., would no doubt have it in his catalogue books, which would assist our correspondent. We know of no better course than copying from the object itself on paper, taking care that each part is *put in the right place*, and avoiding any "artistic" performance in the work, adhering to stern exactitude, so that the result obtained is the *actual machine* on the paper, and then the dimensions of each part can be taken and put on the drawing. We learnt to do this in the manner described above, and soon acquired aptitude in the work, there being no books to help us in those days. We believe there have been some books published on the subject by the Science and Art Department at Kensington. One was written by John Maxton, a clever draughtsman and engineer, who was teacher of engineering drawing to the department, and it would most likely be found in Spon's catalogue. We do not know of anyone who would teach by correspondence, but should fancy if there are any engineering establishments employing draughtsmen near our correspondent, he might be able to arrange with some of the latter to give him instruction for an hour or two of an evening, after his work is over, for a consideration to be agreed upon between them.—C. E.

Repairing Piano.—CLERK.—Your letter is very explicit, and I understand what you require. If your piano has not got an iron plate to which the strings are attached, the pins are driven into hard wood, and these pins in old pianos are usually made of brass instead of iron, and when you tune the piano they often bend, and sometimes break off (I am speaking of the lower pins). The wrest pins, as you say, are probably loose. Now examine very carefully and see that the plank is not split, and if it is not, take out one of the old pins and get a size or two larger; you can obtain them from W. Hughes, 37, Drury Lane, W.C., and they will cost you 1s. 6d. a set, and if the lower pins are bending, I should replace them with small hitch pins. Count the number you require, and obtain at same place; cost about 6d. You can also get what wire you want at 1s. 9d. per lb. Do not string it with heavier wire; a size thinner would be better if for concert pitch. You ought to manage it all right.—T. E.

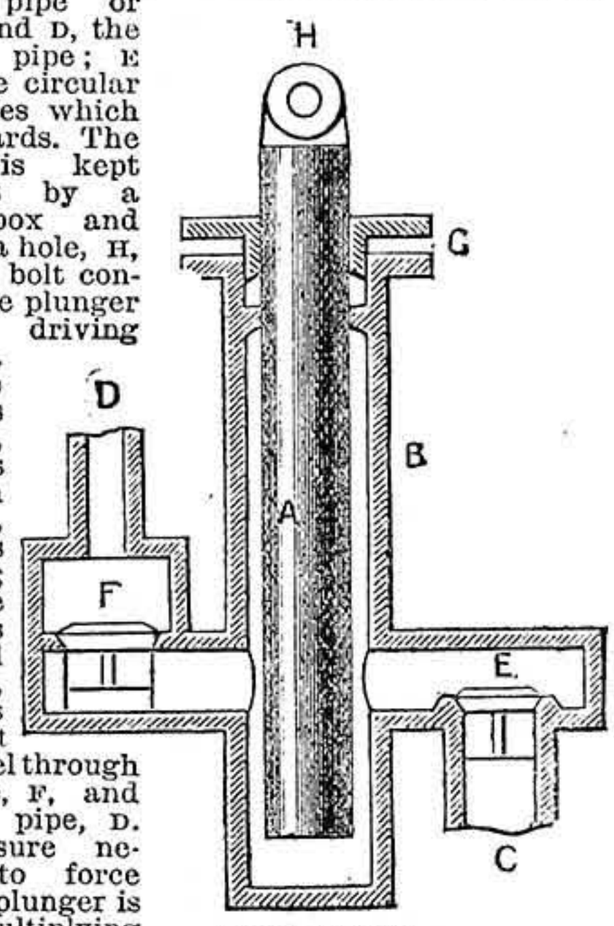
Piano Work.—J. M. F. (*Notting Hill*).—Your best plan would be to get an estimate from a pianoforte maker; he would be able to tell you exactly what it would cost. Try Rudd & Co., Dean Street, Soho Square.—T. E.

Piano-Front Pattern.—J. W. (*Wellington, Salop*).—Sorry you did not succeed in getting the patterns, but as the fret-cutters chiefly design their own, they are somewhat jealous of them. If you could get access to a piano that has a fret front, with a sheet of paper and a shoemaker's heel-ball you could rub a pattern off it by simply laying the sheet of paper on and rubbing the heel-ball over the surface. Or you could purchase a fret from the address I gave you if you send the length and width you require. Frets have given way to panels for piano fronts, although some are partially fret cut.—T. E.

Piano Making.—DOUBTFUL.—If DOUBTFUL will not doubt any longer, but will read my article on stringing, he will see that, instead of doubling the length of the wire, the difficulty is surmounted by increasing the thickness. The measurement, 21½ in., is correct for fourth C. I should think "Sound, Light, and Heat," by Thomas Dummans, price 1s., would suit you; or, as you are near the People's Palace Library, you could see one there.—T. E.

Materials for Piano.—ANXIOUS INQUIRER.—As probably you are aware, you cannot purchase materials for piano making at one firm, as the firms who supply the trade are noted for their special line. For ironmongery, try Hughes, 37, Drury Lane, W.C; for veneers or wood, Witt and Palmer, Drummond Street, Hampstead Road, N.W.; for action, Hallpike, 213A, Mare Street, Hackney, N.E.; for keys, F. Edwards, 53, Southampton Street, Pentonville, London, N. The articles on "Piano Making" appear in WORK, Nos. 29, 32, 36, 41, 43, 46, 50, 51, which you may obtain through a bookseller.—T. E.

Force-Pump.—J. W. (*London*).—The accompanying diagram is a vertical section of an ordinary plunger force-pump; A is the plunger, B the barrel, C, inlet pipe or suction; and D, the discharge pipe; E and F are circular stalk valves which open upwards. The plunger is kept watertight by a stuffing-box and gland, G; a hole, H, receives a bolt connecting the plunger with the driving power. When the plunger is drawn up, water rises through the valve, E, and fills the barrel; when the plunger is pressed down, water is forced out of the barrel through the valve, F, and discharge pipe, D. The pressure necessary to force down the plunger is found by multiplying the area in square inches of the end of the plunger by the height in feet to which the water is raised, and by 0·434 lbs.—F. C.



Force-Pump.

Piano.—GLASGOW.—As I am not acquainted with Glasgow, I cannot refer you to any place to buy your wood, but I presume you would be able to get ordinary spruce deal, such as carpenters use, at any timber-yard or cabinet-maker's shop.—T. E.

Piano Question.—JOINER.—The bottom iron plate runs from the bass end, and lays on the bent side. Of course, there is no necessity for it to run further than the bent side, as there are hitch pins in the bent side. When you receive the plate from the makers, the pins, which are riveted in, will be all in their place.—T. E.

Books on Electric Bells.—READER OF WORK.—Mr. F. C. Allsop's book on "Practical Electric Bell Fitting" is a good work, written by a practical man who has had considerable experience in the work of bell-fitting. It is, therefore, a good book for learners. Another good book on the same subject is Mr. Bottone's "Electric Bells and All About Them."—G. E. B.

WORK Subscription.—JACOB.—The fourth volume of WORK will begin with No. 157, and will be, as you say, "a very good time to begin to take it in." As you are so anxious to help the publication, however, why not begin subscribing to it at once, and induce those "many fellow-workmen" of yours to do the same? Some of our subscribers even adopt the sensible plan of buying an extra copy weekly to send abroad or into the country.—ED.

Bicycle Patent.—C. M. (*Liverpool*).—Referring to reply to F. S. (*Kidderminster*) on page 394 of WORK, the drawing shown does not in many points agree with the description, and the information given would fail to make anyone understand what is meant or what is to be gained by the arrangement. The inventor seems to aim at gearing up an ordinary front-driving bicycle by means of a gear similar to the Rob Roy tricycle, made long since by the Zephyr Cycle Company. With them the gear is simplicity itself; in the reply referred to it is anything but simple or clear, and Fig. 2 of the diagrams is not correctly drawn. I am unacquainted with either the address of the inventor or the number of the patent.—A. S. P.

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Work Volume.—F. R. W. (*Mildmay Grove, N.*).—The third volume of WORK commenced with No. 105.

Watch Jobbing.—CONSTANT READER.—As far as I am aware, there is nothing to prevent you from calling yourself a watch jobber because you have not served your term of apprenticeship; but as to going in for examination for a certificate, I am afraid that it would be useless unless you are very well up in theory and practice, which I am afraid you are not if I may judge from your letter, and therefore I think it would be a guinea spent needlessly, although, could you pass, I believe it would be a good thing; and I should like to see every jobber, watch and clock, go in for the examination: it would be better for themselves, for their employers, and for the owners of watches and clocks, as ninety-nine out of every hundred watches and clocks are, in my opinion, "butchered" up instead of wearing out. Now, as to the verge watch. When the nose of the potance has been filed away to let the wheel up as close to the verge as it will go, and the follower pushed up to keep it, and still it trips, without giving sufficient impulse to the verge, the only thing that is to be done is to put a new balance wheel ('scape wheel), broader in the band, so as to reach the verge pallets; when this is done it usually wants a new dovetail put to the potance, and often a new follower as well, but these you could easily fit up yourself. For a new wheel you must send to the tool shops, say, Grimshaw & Co., Goswell Road, Clerkenwell, London, who will put a new one for about 9d. or 1s. outside.—A. B. C.

Fairy Bells.—W. L. (*Hull*).—See reply to CORKONIAN on page 572, No. 140, which will give you full particulars concerning fairy bells and their construction. Following out the suggestion of the Editor, I give the cost of material, quoting from the list of Chilvers & Co., Norwich. Wrest pins, 6d. per dozen; music wire, 4d. per oz. ring any size. As, however, at least six different sizes are required for bells of twelve strings, Chilvers & Co., supply the strings with eyes already turned at 1s. per dozen, and a whole set of materials—wood for baseboard, sides, blocks, cover, together with screws, wrest pins, and wire—may be had for 4s. 6d. —R. F.

Photographing and Mounting. — J. McB. (*Tain*).—The photographs you require are taken by almost any good photographic firm, and will be mounted as desired. There is nothing outside ordinary portrait work indicated. If you already have the photo *unmounted*, all the photographic dealers supply the cards with sentences suitable for Christmas printed thereon. Marion, Soho Square, W., Fallowfield, Charing Cross Road, and Adams, Charing Cross Road, W.C., all keep them. Percy Lund & Co., Bradford, is also a good firm for them. See also our advertisement pages.—D.

Re-cementing Achromatic Lenses of Opera Glass.—MELITA.—The lenses forming the achromatic combination of your opera glass require to be separated and re-cemented together again with Canada balsam. This can be done with every chance of success if you carefully follow the instructions contained in the reply to A LOVER OF WORK (see No. 58, page 98, of WORK). You will not be able to doctor up the silvering on your looking-glass; it will require to be re-silvered after the old silver has been carefully cleaned off. The process would occupy too much space to be located in "Shop." Your work on "The Antiquities of Athens" is, without doubt, of value, but to ascertain the exact worth you should address your inquiry to a paper such as the *Athenæum*.—C. A. P.

Cold Lacquer.—J. H. M. (*Liverpool*).—It is not much use an amateur trying to make small quantities of lacquer. Leaving out the probability that you would spoil it in the making, it would be more expensive than buying it. If you want a good colour lacquer, I can strongly recommend the lacquers sold by the Frederick Crane Chemical Co., Birmingham. They will send you a sample 4 oz. bottle for 1s., either colourless, gold, or antique brass. See also WORK'S advertising columns.—R. A.

III.—QUESTIONS SUBMITTED TO READERS.

*** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Oil Stone.—A. E. M. (*Cheshire*) writes:—"I shall be glad if anyone will tell me through 'Shop' whether there is any way of softening an oil stone. I have one which to all appearances looks a good stone, but on attempting to sharpen a tool on it, it scratches instead of having a nice working surface. If anyone can tell me what to do to alter it, I shall be greatly obliged, as it is nicely mounted in case, and will save expense of buying another, as I am told they are expensive."

Inlaying.—J. T. S. (*Sheffield*) writes:—"Can any of 'ours' help me with information *re* inlaying wood by aid of fret machine? How are the necessary threading holes hidden? Any hints or reference to any work or article on the subject will be gratefully received."

Staining and Varnishing.—J. T. S. (*Sheffield*) writes:—"What is the best work on these as applicable to amateur requirements?"

Overshot Water Wheel.—F. T. C. (*East Finchley*) writes:—"Will some practical correspondent give the dimensions for an overshot water wheel which will lift to a height of 10 ft. by means of an endless strap and buckets enough water to supply a ½ in. or ¾ in. pipe? The supply pipe is 1 in. bore, and there is 2 ft. pressure of water."

Carpentry Kit. — C. H. J. (*West Bowling*) writes:—"I should be glad if in some future number of WORK some generously minded reader would kindly give a list of the tools, etc., which an amateur should possess before attempting the manufacture of household furniture, or, generally speaking, 'cabinet making.' I have no doubt that there are many others besides myself who have just recently commenced taking in WORK, and are wishful to put to a practical use some of the valuable hints which are given us in WORK. A list such as I have asked for above, with probable cost of same, would, I believe, be read with a great deal of interest by many of us novices."—[Some brother "chip" will doubtless give you the assistance you ask for.—ED.]

Benares Brass Work.—SLIEV DONARD writes:—"I shall feel obliged for information as to cleaning above. The brass is covered with punched patterns, and red, green, and black enamel. I have tried lemon and hot water, but the brass does not keep bright long. Has sea air any effect?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

White Metal.—EDDIFRA writes, in answer to L. S. L. (*Kirkcaldy*) (see p. 622, No. 143):—"You do not state what kind of white metal. There are numerous alloys. If you refer to Knight's 'Dictionary of Mechanics,' p. 63, Vol. I., you will find thirty-two different alloys, all of which are under the heading of white metal, such as pewter, Britannia metal, Parisian white metal, German silver, etc. I have sent a few recipes:—Pewter, 6 parts copper, 112 tin, 2 zinc, 16 lead. Hard Pewter: 4 parts copper, 192 tin, 16 antimony. Britannia metal: 1 part copper, 1 tin, 2 antimony. Another Britannia metal: 4 parts tin, 4 antimony, 4 bismuth, 4 brass. Parisian white metal: 69·8 parts tin, 5·5 zinc, 19·8 nickel, 4·7 cadmium. German silver: 20 parts copper, 16 zinc, 3·4 nickel. Best German silver: 20 parts copper, 8·10 zinc, 5·6 nickel. If I knew what you wanted them for, I perhaps could send you better recipes."

Polishing Vulcanite Pipe Mouth-pieces.—W. L. F. (*Dublin*) writes, in reply to C. H. C. (*Manningham*) (see p. 622, No. 143):—"First take all file marks, scratches, etc., out with very fine emery paper; then polish with a lathe, using a circular buff, with rottenstone and oil; finish off with a soft cloth, using rouge and oil. Take care not to spoil the vulcanite by making it too hot. If C. H. C. has not a lathe, he may glue a piece of soft leather or felt on a flat piece of wood, and rub the work with it, putting the rottenstone and oil on the felt."

Measurement Reckoner. — J. M. S. (*Hull*) writes, in reply to J. G. (*Bradford*) (see p. 574, No. 140):—"You should get the 'Tradesman's Ready Calculator,' published, I think, for about 6d. by Messrs. Routledge & Sons, the Broadway, Ludgate Hill, London. It is a splendid little book, and will suit all purposes."

Ivory Tablets.—W. F. H. (*Dagmar Terrace, Islington*) writes, in reply to SEA GULL (see p. 574, No. 140):—"I am a wholesale maker, and supply nearly all the camera makers in London."

Lapidary Work.—H. S. G. (*Fulham, S.W.*) writes, in reply to SPES MEA (see p. 542, No. 138):—"This is dealt with on p. 473, No. 81 of WORK."

Ready Reckoner for Timber and Glass Trade.—M. (*Bishop Auckland*) writes, in reply to J. G. (*Bradford*) (see p. 574, No. 140):—"The 'Complete Measurer,' by R. Horton, published by Crosby Lockwood & Co., treats of the measurement of timber and glass. 'Haworth's Practical Timber Measurer,' price 1s., post free, from 19, South John Street, Liverpool, is also a good book."

Wooden House.—M. (*Bishop Auckland*) writes, in reply to OLD CHIP (see p. 590, No. 141):—"Try W. Whiteley, Westbourne Grove, Bayswater, London."

Open Sailing Boat.—T. M. (*Liverpool*) writes, in reply to G. A. (*Hornsey, N.*) (see p. 606, No. 142):—"The best dimensions he could have for a sailing boat 19 ft. long are: 5 ft. 3 in. beam amidships, 2 ft. 2 in. deep amidships, and 6 in. deeper at stem and sternpost, which will be 2 ft. 8 in. This gives a sheer of 6 in. If he is going to build a square-stern boat, the width of stern will be half the beam—2 ft. 7½ in.—and the tuck in sternpost to allow stern to fit on will be 1 ft. 6 in. deep. All depths to be taken from top edge of keel. The stem should be made of English oak or elm, as with these he can get the grain right in the round at the foot of stem. The keel, gunwale, sternpost transom, and timbers could be made of American oak. The planking should be either larch or yellow pine."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—T. C. (*Liverpool*); H. D. S. (*Uxbridge*); A. J. C. (*Carlisle*); J. W. (*Upper Norwood*); C. D. (*Bury St. Edmunds*); E. C. S. (*Bristol*); J. S. H. (*Cheetham*); ELECTRA; G. H. (*Oldham*); H. M. T. (*Cornwall*); J. M. M. (*Bristol*); A. R. (*Ottawa, Canada*); F. H. F. (*Homeland, U.S.A.*); H. R. (*Kidderminster*); T. J. (*Preston*); W. S. (*Carrbrook*); J. W. B. (*Huddersfield*); E. J. (*Borough, S.E.*); ADMIRER OF "WORK"; G. S. W. (*Dewsbury*); J. W. (*Loughborough*); TREGER; LOVER OF "WORK"; ZINCO; TELEGRAPH; L. H. (*Brighton*); V. L. (*Bayswater*); G. P. D. (*Aberdeen*); A. H. B. (*Petworth*); H. C. F. (*Great Bedwyn*); J. J. J. (*Morriston*); A. H. (*Manningham*); S. M. A. D. A. (*Tunbridge Wells*); G. C. (*Pendleton*); W. S. (*Appleby*); W. W. (*Forest Gate*); G. C. (*Glasgow*); A. H. P. (*Lewisham*); C. E. L. (*Andover*); JELLY; G. E. S. T. (*Birmingham*); J. J. (*Trealaw*); C. S. C. (*Gravesend*); KILN; C. T. (*Leytonstone*); T. P. B. (*Bradford*); E. A. P. (*Tullow*); A NEW ONE.

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